INTERFACE AGE™

COMPUTING FOR HOME AND BUSINESS APPLICATIONS

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BUSINESS SOFTWARE ISSUE

- WRITE LETTERS
- HANDLE CREDIT
- DO A PAYROLL
- ANALYZE THE BUSINESS

AND

- MAINTAIN NAMES & ADDRESSES

NTS mini series
Unit #3 Continued

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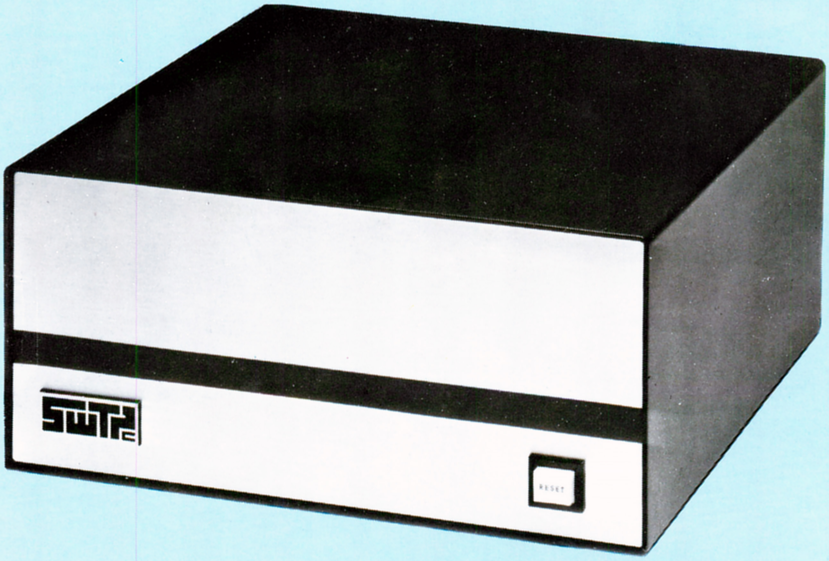
The World's Most Powerful 8-Bit Microcomputer

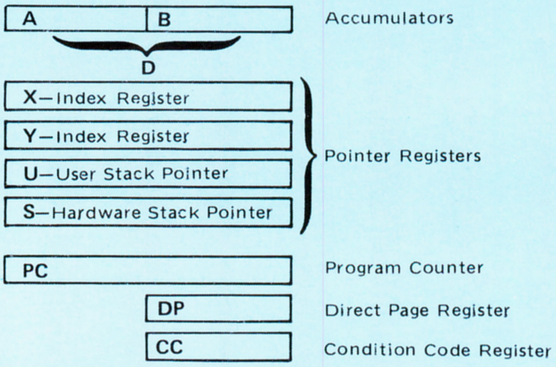


Featuring the World's Most Powerful 8-Bit MPU – The Motorola MC-6809

Welcome to a whole new world of microcomputing. Here at last is a microcomputer with all the speed and power that you have wished for. The MC6809 is an exciting new concept in microprocessors that fills the gap between 8- and 16-bit machines. It provides the power of 16-bit instructions with the economy of 8-bit architecture.

The MC6809 has more addressing modes than any other 8-bit processor. It has powerful 16-bit instructions, and a highly efficient internal architecture with 16-bit data paths. It is easily the most powerful, most software efficient, and the fastest 8-bit general purpose microprocessor ever.

6809 PROGRAMMING MODEL



The greatest impact of the Motorola MC6809 undoubtedly will be software related. Ten powerful addressing modes with 24 indexing submodes, 16-bit instructions and the consistent instruction set stimulate the use of modern programming techniques. Such as structured programming, position independent code, reentrancy, recursion and multitasking.

A memory management system with extended addressing designed into the bus system controls up to 256K bytes of RAM memory. The dynamic memory allocation system, which is part of the multitasking DOS, allocates available memory in as small as 4K blocks.

The MC6809 system is the only 8-bit processor designed for the efficient handling of high-level languages. New addressing modes, a consistant instruction set and easy data manipulation on stacks allows the efficient execution of block-structured high-level code as generated by a compiler like PASCAL.

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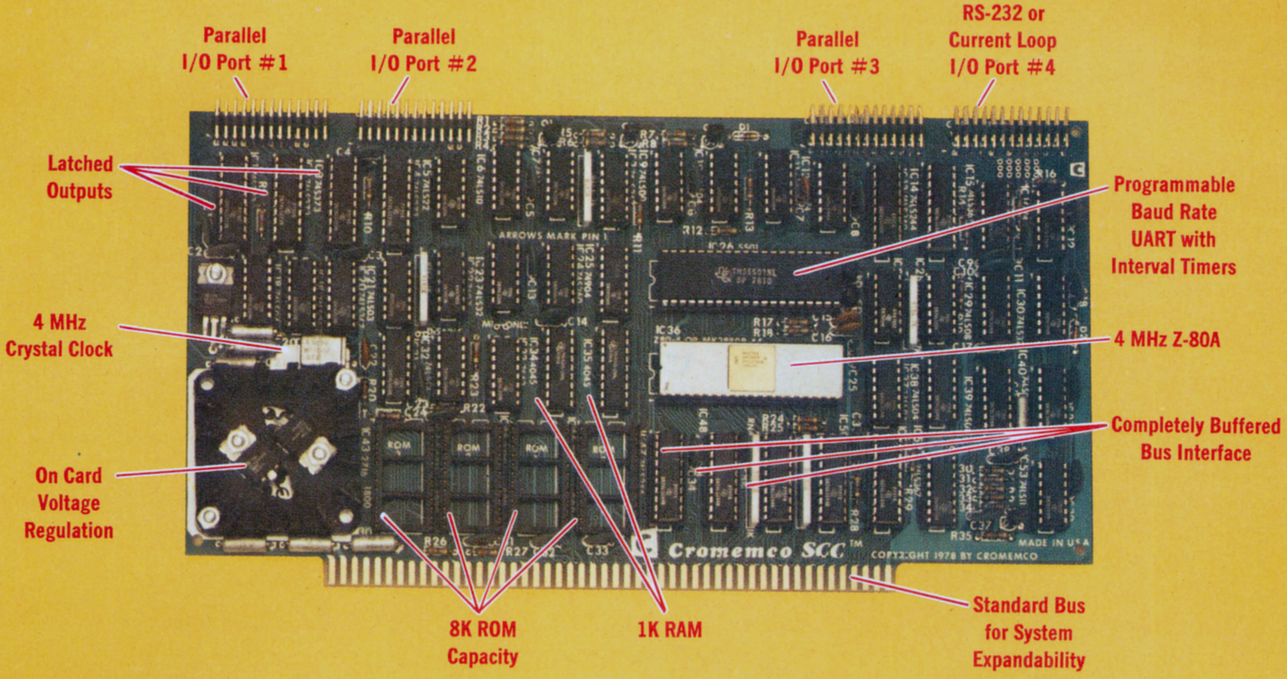
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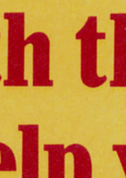
The computer itself is super. Fast 4 MHz operation. Capacity for 8K bytes of ROM (uses 2716 PROMs which **can be programmed by our new 32K** BYTESAVER® PROM card). There's also 1K of on-board static RAM. Further, you get straightforward interfacing through an RS-232 serial interface with ultra-fast speed of up to 76,800 baud — software programmable.

Other features include 24 bits of bidirectional parallel I/O and five onboard programmable timers.

Add to that vectored interrupts.

ENORMOUS EXPANDABILITY

Besides all these features the Cromemco single card computer gives you enormous expandability if you ever need it. And it's easy to expand. First, you can expand with the new Cromemco 32K BYTESAVER PROM card mentioned above. Then there's Cromemco's broad line of S100-bus-compatible memory and I/O interface cards. Cards with features such as relay interface, analog interface, graphics interface, optoisolator input, and A/D and D/A conversion. RAM and ROM cards, too.



Card Cage

32K BYTESAVER PROM card

EASY TO USE

Another convenience that makes the Model SCC computer easy to use is our Z-80 monitor and 3K Control BASIC (in two ROMs). With this optional software you're ready to go. The monitor gives you 12 commands. The BASIC, with 36 commands/functions, will directly access I/O ports and memory locations — and call machine language subroutines.

Finally, to simplify things to the ultimate, we even have convenient card cages. Rugged card cages. They hold cards firmly. No jiggling out of sockets.

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VOL. 4, ISSUE 5
SINCE DECEMBER 1975
MAY 1979

INTERFACE AGE™

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• WRITE LETTERS
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AND
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NTS Unit #3 Continued

THIS MONTH'S COVER

Designed by Fino Ortiz, Art Director. Photography by Don May. Models, left to right, Rufus Ortz, Bruce Bennett, and Sharon Miller. Computer courtesy of Sord U.S.A., Kansas City, Missouri.

COMPUTING FOR HOME AND BUSINESS APPLICATIONS

GENERAL FEATURES

BUSINESS EDITORIAL: PASCAL IS HERE TO STAY 52
by Jim Merritt
INQUIRIES AT EL PASO ELECTRIC ANSWERED IN SECONDS 55
by the IBM News Bureau
PAYDAY 58
by Dave Gardner, Keith Stradling, Randy Jackson and Associate Editor Jim Schreier
INTERFACING WITH COMMERCIAL SOFTWARE 70
by Eric D. Savage
SABR: STATISTICAL ANALYSIS FOR BUSINESS RESEARCH 76
by John A. Lehman
SALES RECORD KEEPING 86
by David Witt

BUSINESS FEATURES

MICROCOMPUTER ANALYSIS OF RETURN INVESTMENT 90
by Timothy J. Burke
WORDPROCESSING IN BASIC, A TRS-80 LETTERWRITER 96
by C.L. Cooper, M.D.
TWO VIEWS OF CREDIT 100
by Jim Schreier, Associate Editor
NAMELIST: A FORMATTED NAME LISTING ROUTINE 103
by Ron Tipton

TUTORIALS

NTS MINI SERIES — UNIT #3 CONTINUED 108
by Walter F. Stephens, National Technical Schools

HARDWARE FEATURES

DOUBLE DENSITY RECORDING ON FLOPPY DISKS 123
by Jefferson H. Harman
SYSTEM OF THE MONTH: THE iCOM 4511 HARD DISK SYSTEM 130
by Tom Fox, Systems Editor

SOFTWARE FEATURES

TEX — A TEXT-OUTPUTTING FORMATTER FOR CP/M 144
by Alan R. Miller, Contributing Editor
A SIMPLIFIED METHOD OF BINARY NUMBER SUBTRACTION 147
by S. Leon Felkin

FREE RUNNING

ASK ELIOT JANEWAY 17
BUSINESS SOFTWARE REVIEW 43
THE COLUMN 20
EDITOR'S NOTEBOOK 6
FROM THE FOUNTAINHEAD 34
INDUSTRY MEMO 46
INVENTOR'S SKETCHPAD 47
JURISPRUDENT COMPUTERIST 35
LETTERS TO THE EDITOR 8
MICRO MATHEMATICIAN 39
MICRO MEDICINE 37
MIND REVOLUTION 50
R.H.D. 24

DEPARTMENTS

ADVERTISER INDEX 152
CALENDAR 28
MICRO MARKET 150
NEW PRODUCTS 135
UPDATE 26

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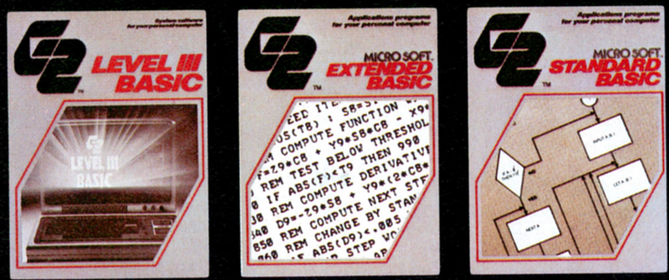
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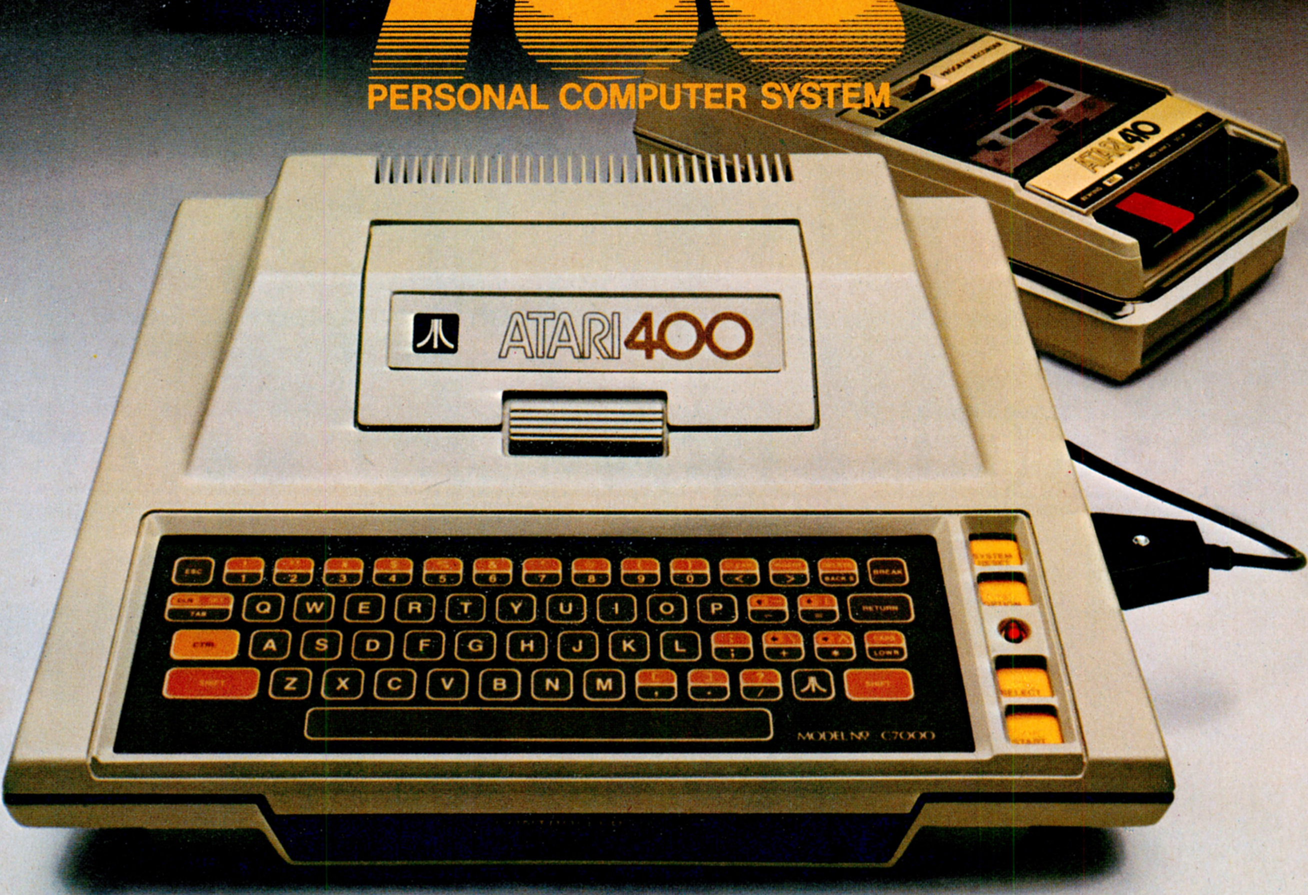

The affordable personal computer that's easy to use even for people who've never used a computer before.

Atari, the company that brings thousands of hours of fun into your customers' homes with the Atari Video Computer System™, now adds a new product concept to the fast-growing personal computer market with the Atari-400™.

The Atari-400™ is the "general purpose" personal computer designed by people for people. Because of its advanced engineering, it's easy to use. Because of its affordable price, it's easy to sell.

With the Atari-400™, educating at home is made simple. That's because it has the advanced capabilities of talking and teaching on home TVs with Atari's exclusive audio/digital cassettes. Currently, the Atari educational program library has a selection of 20 subjects to choose from ranging from Algebra to Zoology.

As for helping your customers run their households, the Atari-400™ can be used for personal finances, record keeping, and most other personal business matters.

Plus, Atari-400™ offers the most sophisticated thinking and action games ever.

That's a lot of ways to offer your customers an easier and better life with one easy-to-use personal computer. You'd have to agree, it's a good enough reason why they'll make the Atari-400™ their first personal computer.

For more information on the ATARI-400™, write ATARI, 1265 Borregas Ave., Sunnyvale, Calif. or call 408-745-2083.

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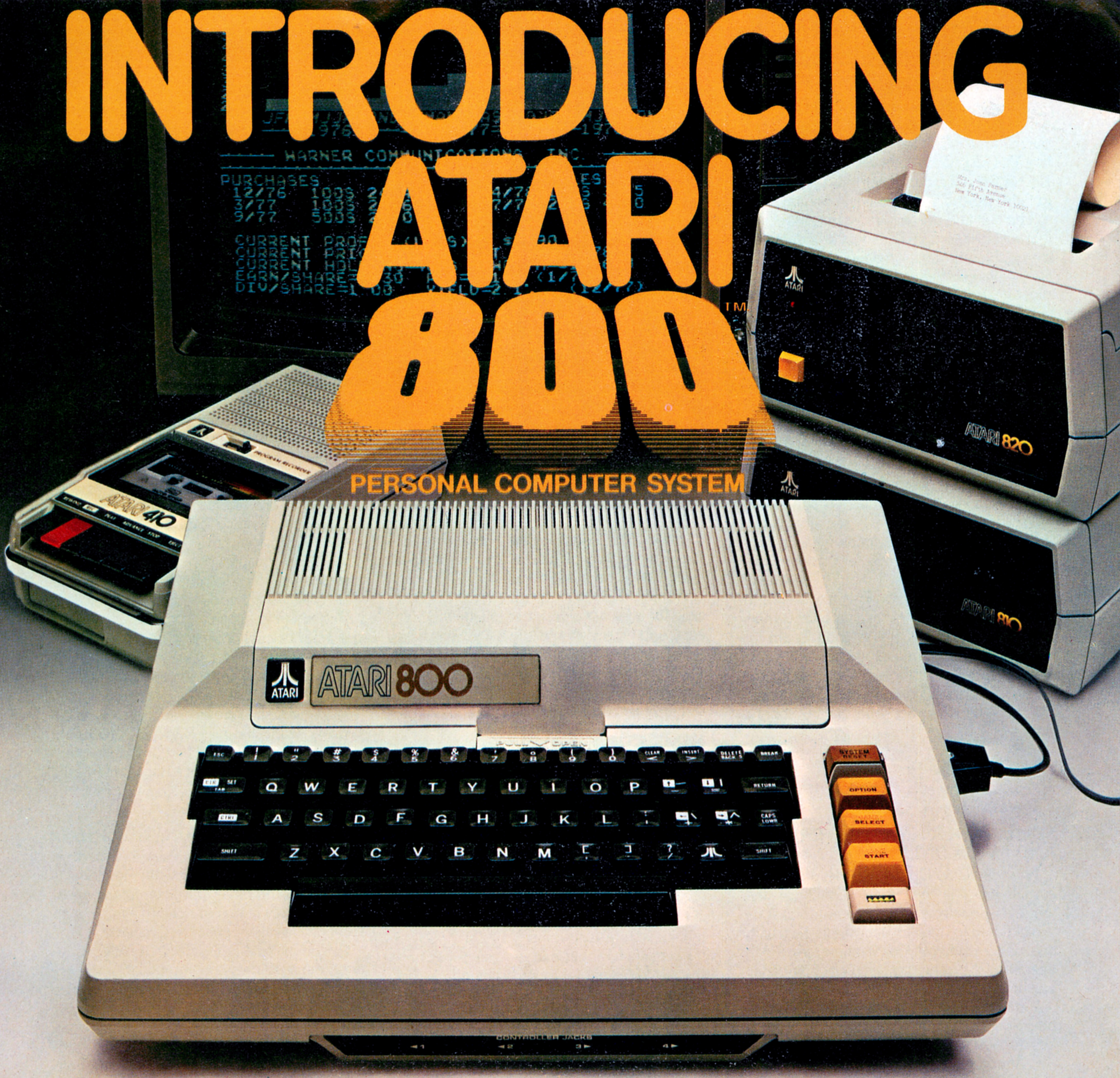
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In addition, the Atari-800™ is an instructional tool that speaks to you, asks questions, and uses the TV screen as its blackboard. Available subjects range from Algebra to Zoology.

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The most sophisticated action and thinking games ever, like Basketball, Chess, and Stock Market, just to name a few.

The Atari-800™. The only computer your customers will ever need to buy.

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CIRCLE INQUIRY NO. 4

EDITOR'S NOTEBOOK

IN THE INDUSTRY

In the January issue of *BUSS*, The Independent Newsletter of Heath Company Computers, Editor Charles Floto made a mention that INTERFACE AGE was the only magazine in the microcomputer industry. We like to think so, and in some very important ways.

The first and possibly most important way that INTERFACE AGE is in the industry is: we try to support our readers by publishing well-written and edited articles providing the most up to date and useful information.

Next, we support our advertisers by devoting more editorial pages to the industry as a whole than any other magazine. Surprisingly enough, both reader support and industry support go hand in hand. By supporting the industry we have a resource at hand that provides us with up to date information on what is happening and is going to happen. Which means, of course, that we can relay this to our readers, and keep them up to date. So you see, being in the industry is something we are proud of and we will remain actively involved in bringing to focus what is happening in the microcomputer industry.

With that explained, I would like to say something about *BUSS*. This newsletter, in my opinion, has a great deal to offer owners of Heath equipment. It is a good forum for establishing communications between users and provides short hints on the use of the Heath systems. Those of you who would like to subscribe can send $7.50 for 12 issues or $11 for 18 issues to:

BUSS
Attn: Charles Floto
325 Pennsylvania Ave. S.E.
Washington, D.C. 20003

SOME OTHER NEWSLETTERS AND MAGAZINES

Amateur Radio Operators—HAMS as they are known—will enjoy the AMRAD newsletter. This newsletter is the communications vehicle used for the Amateur Radio Research and Development Corporation. AMRAD operates the Washington area electronic mail box both on telephone and radio—WR4APC —2 meter FM 147.81 input, 147.21 output. You can join by writing to:

AMRAD
Attn: Gerald Adkins, Treasurer
1206 Livingston St. N
Arlington, VA 22205

or call the mail box at (703) 281-2125. Incidentally, annual dues are $10 per year.

From down under in Australia comes *COM 3*, a non-profit magazine affiliated with the Computer Education Group of Victoria. The magazine is published five times a year and each time gets that much better. For users who are really interested in having a well-rounded library of information resource, *COM 3* is a must item. A subscription and a membership in the Computer Education Group of Victoria costs $35. To find out more about it write to:

COM 3 Ms. E. Bruhn
C/Collingwood Technical College
35 Johnson Street
Collingwood, Australia 3066

Back on top and up north in the Seattle area comes *Northwest Computer News*, from the Northwest Computer Society, P.O. Box 4193, Seattle, WA 98104, recorded info (206) 284-6109.

This magazine/newsletter is tabloid style and has information that is of interest to the club members specifically and to general readers around the country. This is a paper worth taking a look at and offers a fair amount of value for the true hobbyist.

AN IMPORTANT BOOK

Recently, I had the pleasure to pick up a copy of James Martin's *Computer Data-Base Organization*, a $30 book published by Prentice Hall, Englewood Cliffs, New Jersey 07632. This book is the last word on understanding databases and their design. Written in a clear, concise format, even the novice software designer should have no problem understanding its content.

Although the book is written in a manner to make it understandable by almost everyone, it is written with the professional or soon to be professional system software designer in mind. Martin guides the reader through the complexities of database concepts and design with the ease of a skilled artist.

The way the book is designed makes it possible for a software designer to take the concepts and translate them into a workable database manager. You probably won't be able to find this book in most computer stores, but it is available in all the B. Dalton (Pickwick) stores and most technical and university bookstores.

MORE CONSULTANTS

During the past few months, I have received a few more letters from people engaged in the consulting business. One that was of particular interest was: Girl Friday Business Compiler, 10210 Olentangy, Houston, TX 77075, (713) 946-8708. This company is engaged in developing software and also has developed a number of games in the course of developing specific software systems.

Peter Zilahy Ingerman — system consultant, 40 Needlepoint Lane, Willingboro, NJ 08046, dropped me a note with some of his qualifications, which include: conducting feasibility studies to see if computerization is required, and if so what type of system is required. Analyzes work flow, evaluates the suitability of mini systems for specific work functions, and recommends system improvements on existing DP installations.

Peter has about 16 years experience in the field and brings the understanding of a trained engineer into the data processing arena.

Ronald C. Wagener, of Computer Generated Data, 638 Muskogee Avenue, Norfolk, VA 23509, (804) 853-2304, wrote to tell us about his company, which specializes in mailing lists and directories for churches, plus providing useful user information for the TRS-80. As Ron stated in his letter, "Since I know what can go wrong more than any other TRS-80 user, I have valuable information for sale."

Automated Business Enterprises, Inc., P.O. Box 584, Hampton, VA 23669, specializes in business management and marketing, writes John Talley, vice president of the company. They provide quality software and continued support to their customers and feel that the support is the major key to business consulting.

A MISCONCEPTION

Occasionally letters are received and published by publications telling of trouble with a particular company. Unfortunately, due to similarity of names of companies, an innocent bystander is hurt for the misdeeds of another. So is the case of Computer Systems Distributors, Inc., 3470 Erie Boulevard East, Syracuse, NY 13214, (315) 446-1285. This company has an excellent reputation and has not to our knowledge ever had any difficulty with its many customers. Hopefully, readers who have associated Computer Systems Distributors Inc. with a similar company in Syracuse will realize the error and understand that CSD has made its reputation on good business ethics and customer support.

THE RETIREMENT GAME

Everyone wants to retire, right? Well, John Heldt, 2205 Riordan Drive, San Jose, CA 95130, a quality control engineer, has found a way to do it from the comfort of his easy chair. John has developed a game called "Masterplan for Quality Confusion," a quality game for calculator buffs. During the course of the game you advance through the levels of quality control and you can even be fired. The goal of course is to reach retirement. The game is an interesting approach to calculator game playing plus learning a little about quality control. This isn't a commercial venture for John, but more of a hobby. He would like to hear from you.

ABOUT COPYRIGHTS

I frequently am asked questions about when a copyright is interfered with. The most basic answer is when copywritten material is used for commercial purposes or personal gain. The key is that of making money with someone else's copywritten material.

All the material in INTERFACE AGE is under the magazine's copyright, with some exceptions. These exceptions are the few articles that we have published with the author's copyright, but this presents a problem. Before this material can be used by the author or the magazine again, a release of copyright from both parties must be obtained, because in effect a double copyright exists. Because of such difficulties, we no longer accept author copywritten material for publication, but we are very free in providing letters or authorization of use of articles, except for commercial ventures.

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A DYNAMIC NEGATIVE

A friend of mind, who shall remain nameless, recently sent me a copy of his seventh corollary concerning dynamic negatives. I personally think it says a lot in just a few words: "The efficiency and profitability of a corporation is inversely proportional to its number of vice presidents." Wonderful words and oh so true.

—carl

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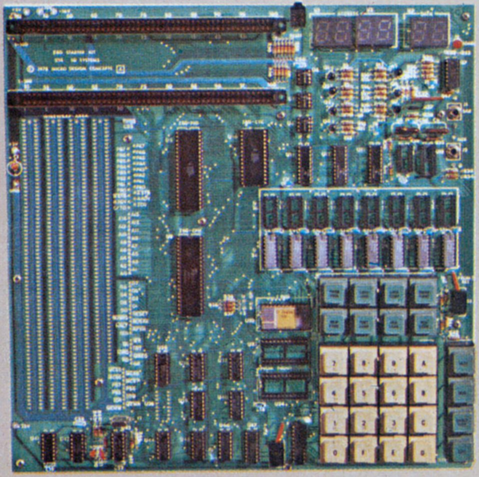

Z80 Starter Kit $249.00

Z80 Starter Kit

The State-of-the-Art Microcomputer Kit that gives you the Z80 microprocessor to learn step by step through SD's comprehensive manual. Examine the features of the Z80 Starter Kit:

- Keyboard and Display
- Audio Cassette Interface
- PROM Programmer
- Wire Wrap Circuit Area
- 4 Channel Counter/Timer
- 1K Bytes RAM
- Two Parallel I/O Ports

Total Business Software

SD Systems brings you TOTAL System Software for the SDS-100. Most businesses do not keep full time programmers on staff. This is why SD brings you full business software for the SDS-100. Special modifications can be made by SD Software Engineers to fit your requirements. Program updates are sent to users when they are developed. The SD Business Software extends from General Ledger and Payroll through Accounts Receivable and Mailing List. Proven performance programs that are factory supported make the SDS-100 the TOTAL System for your needs.

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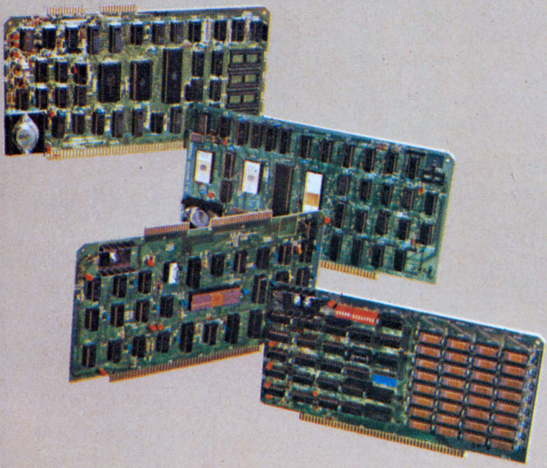

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LETTERS TO THE EDITOR

A DIABETIC AND THE PET

Dear Editor:

Being a diabetic I was very interested in your article "It's No Big Miracle," in your December 1978 issue.

Having a PET computer with no line printer, I decided to use the basic chart idea from your program and write a similar program and have the chart display on my PET. Also because of not having a line printer and still wanting to be able to keep a record of my charts, I write the chart information onto Mag Tape. This allows me to search by date and get a display on the PET of any day I want to review.

I would be glad to send anyone a listing or even the program on Mag Tape if they send me a blank tape.

Frank Henn
4811 Verona Dr. N.W.
Calgary, Alberta T3A 0P5

IN RELATIONSHIP TO BUSINESS

Dear Editor:

The recent business section and letters to the editor about business software available for microcomputer systems have prompted some thoughts.

I have followed the development of microcomputers and their application to business since the introduction of the original hobby kits. It is true that for many financial applications the current crop of microcomputer systems and available software is very good.

However, if the businessman's needs include word processing, none of the software currently available is truly suitable to the task. (With apologies to the current vendors.)

Standalone wordprocessors do not address the problem of an inexpensive and integrated system. Minicomputer based systems are still too expensive.

The J500 recently introduced by Jacquard Systems effectively solves the problem. Its price of $9200 includes CRT, keyboard, 16-bit CPU, 64K-128K memory, dual floppies and controllers for floppies, hard disks, printers and communications lines. The software includes the number 1 rated (by Datapro) wordprocessor in the shared logic category (TYPRITE). And the software is totally integrated. The word processor can access and manipulate files created by general ledger, accounts receivable, etc. and vice versa.

Once the user has experienced the power of a professional level wordprocessor (such as TYPRITE) he will never again be satisfied with the currently available products.

David Harralson
Hollywood, CA

A FLOPPY ROM™ USER

Dear Editor:

I have been a subscriber to INTERFACE AGE since October, 1976, and I got the final kit package for my Altair 680b in about April, 1976.

When Robert Uiterwyk's 4K Basic on Floppy ROM appeared in the May 77 issue of INTERFACE AGE, I thought it was very interesting; but I did not, at the time, have the hardware or the knowledge to implement it.

Within the past few days I finally got around to trying the Floppy ROM. It works great. Till this time I have been using the 6800 MPU instruction set to program in HEX through my ASCII keyboard.

For future programs I would like to see 1) a relocator program; 2) a real-time appointment calendar program with a subroutine for present Day-Month-Year; 3) a cash-register program; 4) a multiple-interrupt-servicing program; 5) a time-share program. All these programs should be offered for 6800, 8080, and Z-80.

Alternatively, I would like to see a program to convert programs from one instruction set to another. Also, any programs on Floppy ROM should include an assembly listing so that necessary patches can be accomplished by the user. Or possibly an assembly listing could be requested from INTERFACE AGE for those interested in a particular Floppy.

INTERFACE AGE is an excellent magazine, and I hope you keep the hardware and software articles flowing.

Robert Ousterhout
Ogdensburg, NY

Roger, since Floppy ROM Number One, we have published a significant number of useful programs on the ROM. More importantly, with the introduction of IAPS™ in May of 1978, we made the Floppy ROM concept even more useful. We do have some other significant changes in the making and will make the Floppy ROM even better.

FROM ACROSS THE ATLANTIC

Dear Editor:

I recently finished reading the December 1978 issue of your magazine, which I have subscribed to for one year. It is the first magazine specially for the home computerist (I like this word, which I saw for the first time printed on your envelope) which I am reading and I have to say it is very nice and teachable for me.

A friend of mine has been doing a chess program for a Wang 2200VP minicomputer with 64K and now I have found in your 1978 Index to Microcomputer Books three books dealing with chess and even in one is an already written chess program! So together with this letter three other letters will go to your country directly to publishers of chess computer books.

Tomorrow I shall start to try Pico-Fumi game on above mentioned minicomputer and later I should like to convert that game on my programmable TI-59 with the printer.

I am very looking forward to next issues of your magazine, because all three 1979 coming attractions will be very interesting, teachable and useful for me.

Libor Stolc
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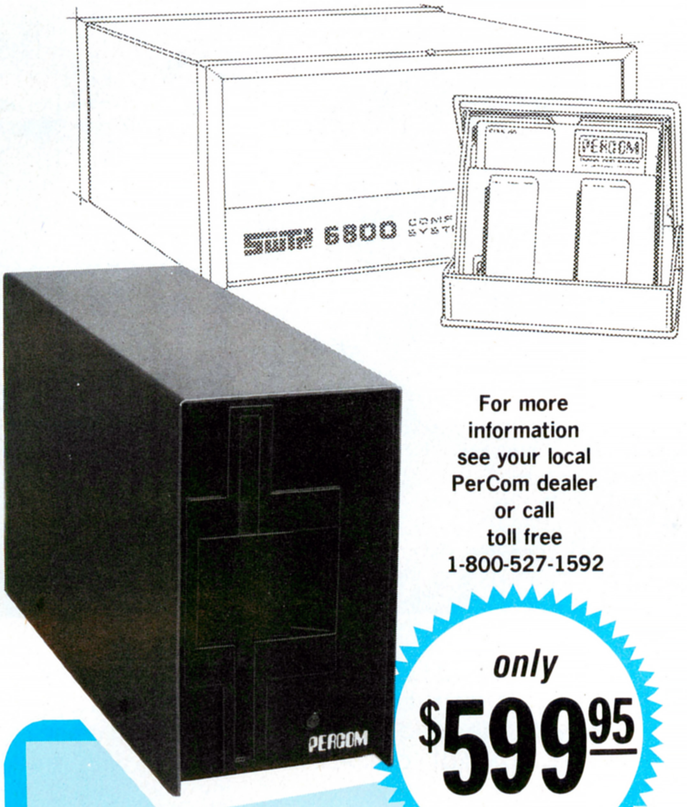

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SOME IMPORTANT FIXES

Dear Editor:

This letter is in reference to the article "An Interrupt Driven Floppy Disk Controller for the S-100 Bus" by R. Wright and C. Quinn (May 1978).

Since the article was published, I've acquired two FD400 F/D drives, built power supplies and cables, wire-wrapped the controller board, and have nearly finished check-out in an Altair 8800 system.

Although I recognized the relatively high technical level of the article, I'll have to admit that it turned out to be a much greater challenge than expected, and also much more rewarding. It was quite a thrill to finally write and read back the first full track of data without error, and to know exactly what was going on.

Check-out, of course, was not without difficulty. In addition to a couple of my wiring errors, the following schematic errors were identified:

1. U27D input and output pins (9 and 10) are shown reversed.
2. U8A and B are shown connected so that the MOTOR ON 0 signal enables the DOOR OPEN 1 input, and vice versa. Reversing the connections to U8-1 and 4 cured this problem.
3. U13A, B, U16A, B and U12B one-shots will not work when wired as shown. The 9602 requires that an unused positive trigger input be tied to ground and an unused negative trigger input be tied to +5V for proper operation. The opposite is shown on the schematic.
4. The HEAD LOAD DELAY one-shot (U128) is shown with 47 mfd and 22K for external timing values. These values calculate out to 310 ms delay. Although the schematic indicates an intended delay of 35 ms, the FD400 manual specifies 40 ms as the correct value. I found that replacing C13 with a 6.8 mfd 10% 150D type tantalum capacitor produced almost exactly 40 ms.
5. The connections to the phase comparator inputs (U20-1 and 3) are shown reversed, with the result that the frequency correction voltage applied to the VCO (U23) is in the wrong direction.
6. The CLOCK WINDOW/DATA WINDOW flip flop (U15B) clock input is shown coming from the QC output of counter U20 via inverter U10. This results in clock/data separator windows being generated every 1 μsecond, which is double the correct rate. Moving the connection from the QC output (U20-12) to the QD output (U20-11) solved this problem. The text is in error in the description of the operation of this flip-flop. Since the PLL is operating at 8 MH, which is 32 times each bit cell, and a bit cell is defined as one clock pulse and one data pulse (if data is a 1) occurring in a 4 μsecond period, it then follows that flip flop U15B should be clocked every *16* counts of the PLL to provide a *clock window/data window every 4 μsecond,* not every 8 counts and 2 μsecond, as stated.

Two other problems, both having to do with the noisy Altair S-100 bus were identified.

1. Noise on the PSYNC line caused the ACCESS WAIT LOGIC shift register to be cleared, and in turn, the PRDY line to go true prematurely. A 330pf capacitor to ground at U30-8 cured the problem.
2. The other glitch was on the enable inputs to U26, 27 and 28 tristate buffers which gate data back to the CPU. This glitch occurred during the time the CPU requires data to be stable. It was traced to noise on address lines and cured with a 330 pF capacitor to ground at U32-4.

There is a disagreement between the software and the hardware in the program listing. In the subroutines for READ, WRITE and etc. The code 03H is output to the control mask port. This code, according to the schematic, will turn on the activity lights for drive 0 and 1. It will not turn on either motor, or enable interrupt instruction logic. If the CPU attempted to execute these subroutines, it would halt and wait for an interrupt which could never occur.

Again in the READ and WRITE subroutines; the READ (or WRITE) command is output to the 1771 command register, and this is immediately followed by an input from the status register. The Western Digital data sheet on the 1771 states that "When writing into the command register, status is not valid for some 12 usec later." Obviously not enough time has been provided for status to become valid.

In spite of the rather long time it has taken me to get the disk system and controller up and running, I still think it was a very worthwhile experience. My thanks to the authors for their efforts.

There is still one question for which I have not found an answer; What is the purpose of S (bit 0) in the READ TRACK command? I find that if I make this bit a 0, I can read a track without error, but if I make it a 1, I read back garbage. Can anyone explain, please?

P.S. How about publishing a similar article on a REAL TIME CLOCK or a hardware floating point arithmetic card for the S-100 bus?

Bob O'Brien
15209 Prairie Ave., #29
Lawndale, CA 90260

Bob, we appreciate your comments on the difficulties you encountered. Regarding a real time clock, it's possible we may have one coming up.

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Shugart

8080 STILL IS GOOD

Dear Editor:

In your February issue there is an article by Rod Hallen on the Z-80 comparing it to the 8080. Listed on page 96 there are two programs to move data, the Z-80 being less than half the size of the 8080. True, the Z-80 is faster and does more, but please give the 8080 a fair comparison.

While four bytes isn't all that much, in the sample shown that comes out to be over twenty percent larger, which on a larger program could amount to quite a bit.

Listed Version

```
LXI    H,ADDRESS
LXI    D,DESTINATION
LXI    B.LENGTH
MOV    A,M
STAX   D
INX    H
INX    D
DCX    B
XRA
CMP    B
JNZ    XXXX
CMP    C
JNZ    XXXX
```

Total 23 bytes

Corrected Version

```
LXI    H,ADDRESS
LXI    D,DESTINATION
LXI    B,LENGTH
MOV    A,M
STAX   D
INX    H
INX    D
DCX    B
MOV    A,B
ORA    C
JNZ    XXXX
```

Total 19 bytes

I'm looking forward to your graphics issue. I hope it contains more of hard copy graphing, etc. and methods rather than just plotting on the CRT (i.e. interfacing to a plotter, Diablo, Qume, etc.).

L. Barker
Chicago, IL

We are planning to get into how graphics are generated, both from a hardware and software point of view. Plus provide information on the hard copy graphic peripherals. In fact, we would like to hear from anyone working in these areas.

A GENUINE NEED

Dear Editor:

Due to throat and stomach cancer operations, I am not able to use the telephone company's vibrator unit to talk with. I have heard of a unit currently being developed that has buttons and a speaker so you can carry on a conversation over the phone.

Don't confuse this with the children's spelling units or with the language units that write things out with LEDs. The one I read about spoke only language to talk and converse with.

Have you heard about these experimental units? If you or any of your readers know about them, I would like to get the address. I sure would like to get it now as I can only write to communicate. Could you or your readers help me in some way?

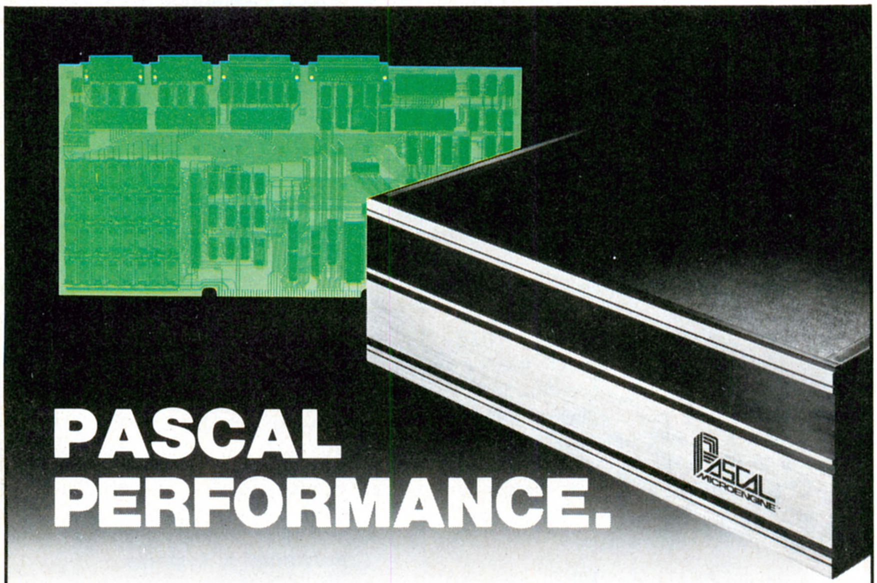
Herbert H. Freeman
4522 Hamilton St.
San Diego, CA 92116

SOME POINTS OF VIEW

Dear Editor:

Numerous letters have appeared in INTERFACE AGE and other magazines concerning the uses of microcomputers in business. Most of these letters are hardware or software oriented and concern only a small segment of one of these fields. The microcomputer is different from the larger computers and so is the applicable software. Its greatest potential lies in a different direction.

Microcomputers can be used where it would be impractical to use the larger and more expensive machines. Up to the present, few people have been concerned with interfacing microcomputer systems with the



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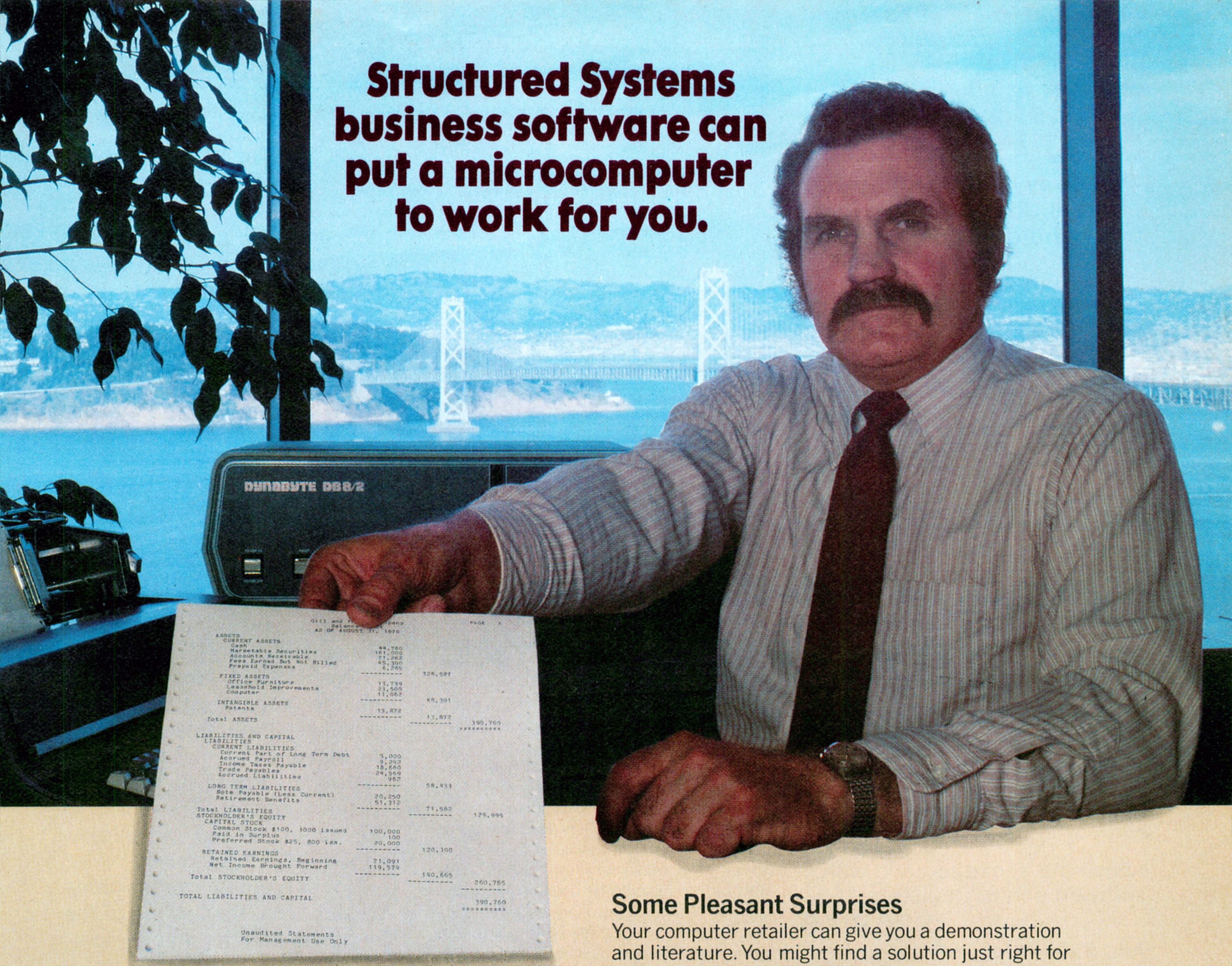

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                              Gill and F          pany                PAGE   1
                               Balance     t
                             AS OF AUGUST 31, 1978
    ASSETS
      CURRENT ASSETS
        Cash                                         44,760
        Marketable Securities                       161,000
        Accounts Receivable                          71,262
        Fees Earned But Not Billed                   45,300
        Prepaid Expenses                              6,265
                                                 ----------    328,587
      FIXED ASSETS
        Office Furniture                             13,739
        Leasehold Improvements                       23,500
        Computer                                     11,062
                                                 ----------     48,301
      INTANGIBLE ASSETS
        Patents
                                                     13,872
                                                 ----------     13,872
    Total ASSETS                                             ----------    390,760
                                                                        ==========

  LIABILITIES AND CAPITAL
    LIABILITIES
      CURRENT LIABILITIES
        Current Part of Long Term Debt                5,000
        Accrued Payroll                               9,242
        Income Taxes Payable                         18,660
        Trade Payables                               24,569
        Accrued Liabilities                             962
                                                 ----------     58,433
      LONG TERM LIABILITIES
        Note Payable (Less Current)                  20,250
        Retirement Benefits                          51,312
                                                 ----------     71,562
  Total LIABILITIES                                          ----------    129,995
  STOCKHOLDER'S EQUITY
    CAPITAL STOCK
      Common Stock $100, 1000 issued                100,000
      Paid in Surplus                                   100
      Preferred Stock $25, 800 iss.                  20,000
                                                 ----------    120,100
    RETAINED EARNINGS
      Retained Earnings, Beginning                   21,091
      Net Income Brought Forward                    119,574
                                                 ----------    140,665
  Total STOCKHOLDER'S EQUITY                                 ----------    260,765
                                                                        ----------
TOTAL LIABILITIES AND CAPITAL
                                                                           390,760
                                                                        ==========

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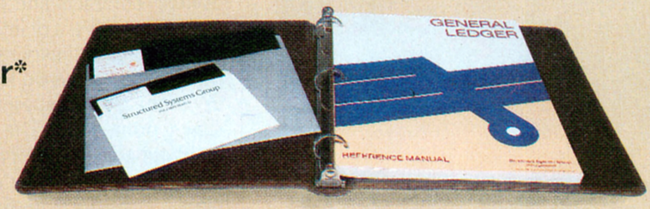

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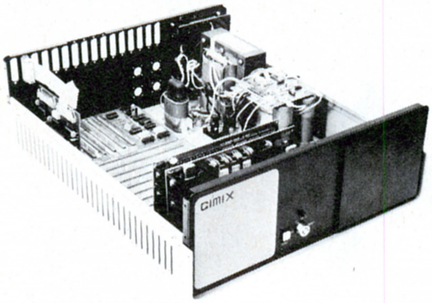

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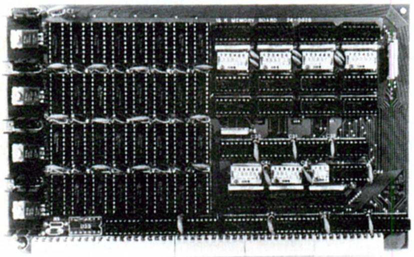

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CIRCLE INQUIRY NO. 21

real (business) world. Microcomputer systems consist of a lot more than a microprocessor chip.

The businessman is subjected to many constraints involving time and money, either directly or indirectly. Government regulation of business takes many forms, all of which influence the time and money that a businessman has to devote to his business. Government supports itself with taxes and uses these same taxes to regulate business. The time required to prepare and maintain the records required by government, upon which it bases its taxes, represents a very real expense to the businessman.

Once this expense is incurred, it is up to the businessman to make the fullest possible use of the information that he has accumulated. Microcomputers can help to reduce the expense of accumulating this information and can help the businessman to use the information better.

A microprocessor chip is a small part of a microcomputer, and a microcomputer is a small part of a fully utilized computer system. Such a system would be used for word processing, accounting, inventory control, communications, and a lot more. There are many schools that teach FORTRAN and COBOL but few teach BASIC. Most microcomputers require a knowledge of BASIC. Those of us who wish to move into the gap between the microcomputer manufacturer and the microcomputer end user must do so from the side of the businessman.

Video terminals, printers and memory devices are properly considered to be accessories in a microcomputer system. They also can and should be used as part of our system of communications. Communication between two or more terminals is common, possible and desirable. It would be much easier to discuss a tax return with your accountant, or a government auditor, if the return appeared on terminals in each office. This also applies to price lists, real estate listings, contracts and other papers.

With the advent of intelligent terminals, including small, inexpensive, dedicated computer systems, it is no longer necessary to tie up a main computer while information is slowly printed out. The task can and should be assigned to the terminal, freeing the main computer for other work. With information readily available from memory or a memory device, much printed matter can be eliminated. Much of the information that is now printed is not used, as with the book that is kept for the use of a few pages, or used only once. It must be remembered that elimination of necessary printed matter can be disastrous.

Interfacing the real, business world to the manufacturers of microcomputer hardware and software requires communication and flexibility. The data must be received in a form that the recipient can use. Outside constraints on both parties must be taken into account. Flexibility is required because business conditions and the constraints on business are constantly changing.

Robert D. Jones, MBA
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The PASCAL Notebook will include a complete compiler based on P-4 implementation, the last implementation written by Niklaus Wirth, the designer of the language. The P-4 is in the same line as the widely-known UCSD compiler.

Not only will the series detail some of the finer points of the language and the steps necessary for implementation, but it will also explain the reasoning behind their implementation. By explaining the theory that formed the basis of the language, Davis will give the reader an understanding of all languages. By the end of the tutorial, serious readers will be able to write their own language.

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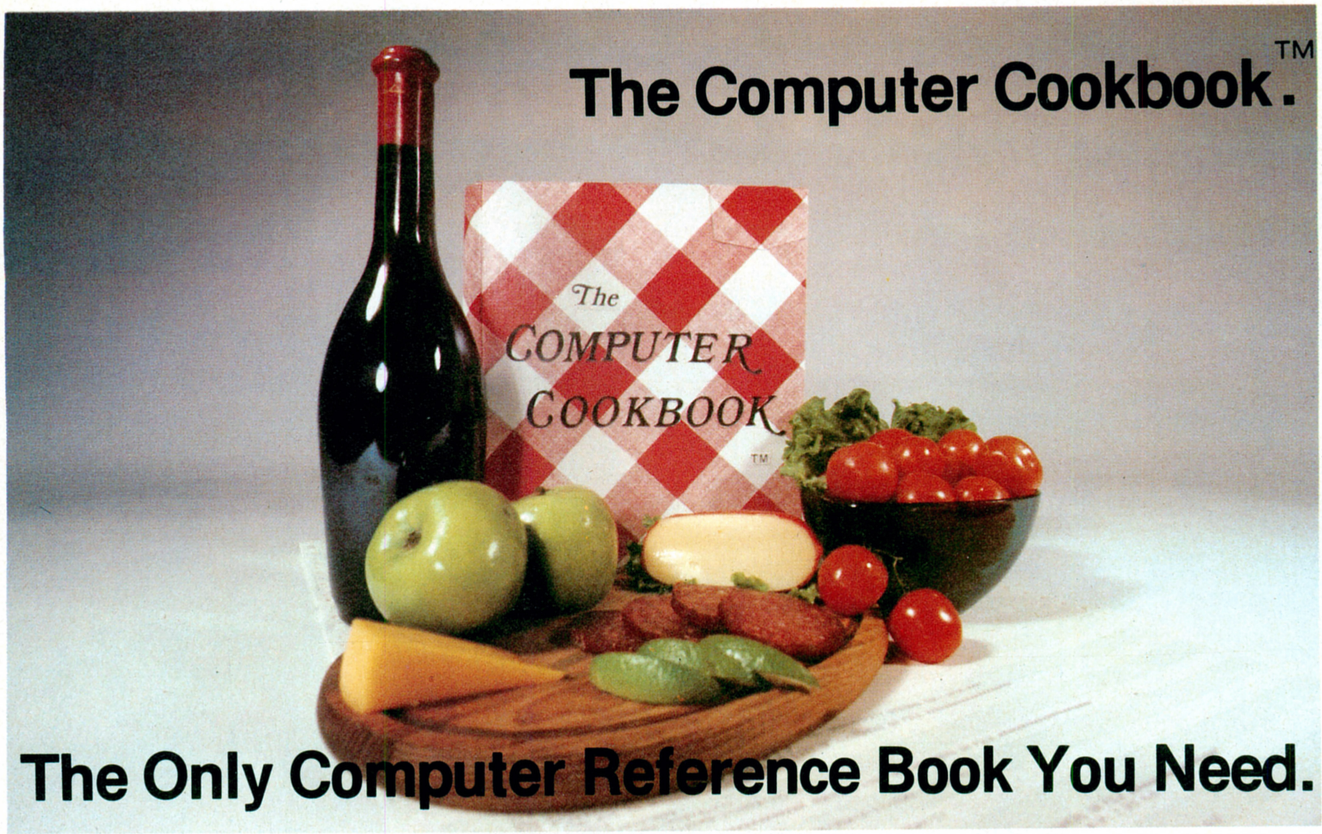

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Ask Eliot Janeway

Interview by Terry Costlow, Assistant Editor

Computer stocks were very popular for some time in the 1960s. With the boom in chip technology, do you think that computer stocks can become hot again?

JANEWAY: No. If you read my investment manual, "You and Your Money," I've gone to great pains in the chapters on stocks to explain that the most fundamental of all distinctions in investment matters is that between a company and its stock. There's no assurance whatever that strength in a business will spill over to strength in the stock of that business.

As often as not, when a company does very well, its stock will be under very severe pressure. From a pure and simple business standpoint, I can see any number of reasons why the stock of IBM could have been expected to regain its lost vigor. Of course, the company itself is doing very well.

Nothing is more natural than to jump to the conclusion that because you know a given company is doing very well, it makes sense to go out and buy the stock. That line of thought drives you back into this fallback question: Do the prices of stocks multiply the earnings reported for the companies behind the stock?

My view, based I think on experience and on the practical reasoning behind that experience, is that they almost never do. The multipliers change. In other words, if a stock sells at 10 on the basis of earning $2 a share, so that its PE multiplier is 5, and then drops to 8 while its earnings double to $4 a share, its multiplier will drop to 2. Multipliers are changing all the time. This proves earnings don't predict prices.

Do you think that this would be a good time to invest in over-the-counter computer stocks?

JANEWAY: Absolutely not, because the governing consideration is the level of interest rates. There's an old rule about business: when a company doesn't do well, it needs money. But when a company does really well, it needs still more money.

Now we're living in a period of 15 percent money. Entrepreneurial businesses are needing to spend up to 18 to 20 percent for money if they can get it. If businesses are doing well, the money market isn't going to say "OK, buster, you're doing so well and you're in the computer business and you're a graduate of Stanford. Just for you, we'll make an exception and you can get 5 percent money."

For them to sell stock is brutal. If they can't get credit to bootstrap, they're going to have to try to sell skin. That's bearish for a stock.

But wouldn't that be the cheapest way for them to get capital?

JANEWAY: They're damned if they do and damned if they don't. It depends on how sophisticated they are.

Physicists are rarely sophisticated financially. Can they get "mothership" financing from a big supplier? That's the cheapest way. If they have proprietary product or technique, can they get an outfit that knows its business and that knows that they can do something economical to advance them money? The normal rule is that companies that have it, who get their start developing it during bad money conditions, either wreck the future markets for their stock by giving private placements of warrants in letter stock, and just proliferate a lot of new supply over the market landscape. Or they get in over their heads in debt.

Are there any stocks that you'd say are good to invest in at this time?

JANEWAY: If we go on the rule that money is going to be worth pretty much 15 percent and if we invoke my other investment rule that you need three percent of what money's worth to make an investment in an income paying security worthwhile, there's only one class of income paying security that meets that definition. And that's

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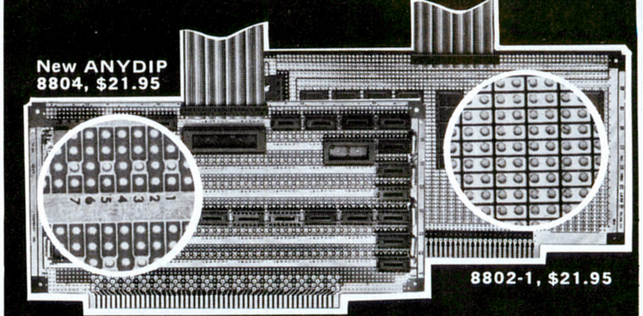

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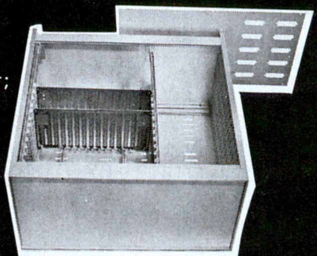

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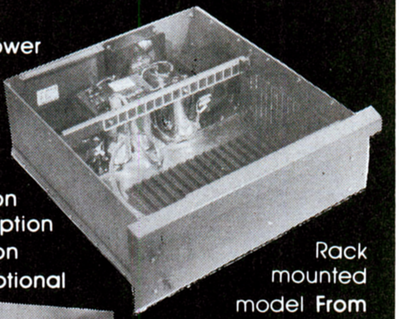

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the uranium-bearing South African gold stocks which are yielding 20 to 35 percent.

Speaking for ourselves, we have about 45 percent of our profit-sharing trust portfolio, which pays no taxes on its income, invested in them. The only other kinds of securities that are safe from capital loss during this kind of fever rash in the money market are securities which are paying no return whatever. And those tend to be divided into two groups: workouts from bankruptcy, and special situations, like any computer stocks that have prorietary technology.

If you made money last year in a computer stock that will not pay a dividend and that's well financed, and the company's small enough not to collide with competition from the Hewlett-Packard category, it would seem to me that you'd have to limit your investments to specialties. The major second-rung stocks of the category of Hewlett-Packard, and I don't mean to single it out, are going to come under obvious pressure because they represent pioneering achievements by innovators of the last generation who are now in their seventies. They're thinking about grants to colleges and grandchildren. They can get 5 percent to 5½ percent tax-free for taking no risk, 28 percent capital gains rate. So the incentives are rising for them to sell their stocks and switch into tax-exempts.

People do get sick. People in those brackets who get sick run up bills of two to five thousand dollars a week as fast as you can say IBM. So you're going to have a rigorous year in continuous selling pressure on those high-performing stocks with high profit margins.

And, of course, if you know of smaller companies with proprietary technology and small capitalization, where competitors or suppliers or customers not in the anti-trust spotlight found it expedient to take those companies over, you could find a computer stock on the takeover list, and you'd have a winner.

Mind you, when you have computer companies that are involved in any sort of regulatory sensitivity, increasingly the entrepreneurs, let's say of medical technology, they wouldn't want to be taken over.

The individual entrepreneur of the kind who built Hewlett-Packard or Digital hasn't got the patience or the temperament to cope with this endless harassment.

I'm 66 years old. All through my career I have regarded land as a passive, "grandchildren's" investment. It has ceased to be that. It's been turned into the kind of asset that only companies can afford to hold. It's an operating asset because of the zoning and environmental authorities.

Do you see a leveling out of land prices in the near future?

JANEWAY: No. They'll continue to escalate because the land stock of this country has been effectively cut by at least a third, maybe more, by unresisted environmental encroachment. You can't use up to a third of the land that you bought.

One might say that it's a tradeoff. If you have a thousand acres worth a dollar an acre, and they told you that you couldn't use 333 of those acres, you've paid for 1,000 and wound up with 666. And if there's an economic demand for 1,000 acres, each of the 666 that you could use would be worth more that $1 a acre. So it is an offset. And some landowners are saying, "Well, that's great." And, "I'm rich, that suits me. Some weaker owners will be chopped off and I'll buy them up at discounts." And eventually the regulatory pendulum will swing and people will have had enough of over-regulation and they'll say, "Let's make a buck."

See, we're on a moral cycle in this country. We go from the syndrome of Saturday night in a mining camp to Sunday morning on a mourner's bench. We've been on the mourner's bench now, doing penance for affluence while still enjoying affluence. We've gone a little schizoid. The strange part now is, as the pocketbook nerve pinches, I think we'll swing back a little to the "Let's make a buck" syndrome.

I don't think it's the end of the world, but being frank in answer to your question about land values, they are not going to come down. However, I immediately temper that judgment with the consideration that it's going to cost you money to own land while you carry it. ☐

Questions for this column should be sent to Ask Mr. Janeway, P.O. Box 1234, Cerritos, CA 90701. One question per letter, please. Personal replies are not possible.

The comments expressed in this column do not necessarily reflect the views of this magazine or the microcomputer industry. —The editor.

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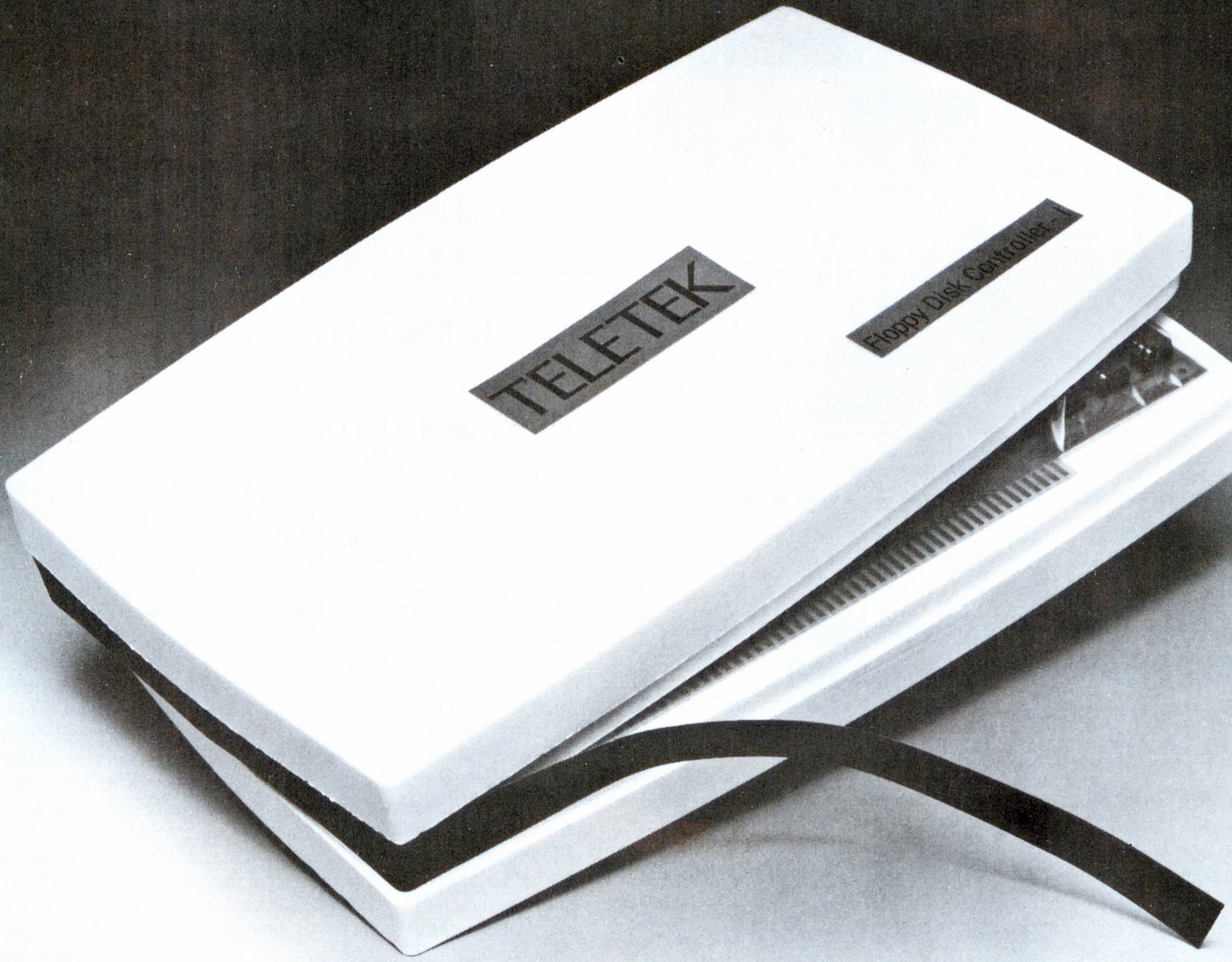

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CIRCLE INQUIRY NO. 36

the Column

By Mike Wolf, Senior Engineer
Jet Propulsion Laboratory
Pasadena, California

TRS-80 ASSEMBLER FIX (Level-1). . .Dump It!

Having bought my TRS-80 mainly because I fell in love with the Z-80 CPU instruction set, I quite naturally bought the Radio Shack Editor/Assembler soon after the purchase of my Level-1 machine. As soon as my 16K chips were installed, I eagerly brought my assembler "up" and began playing around with that fantastic repertoire of Z-80 instructions.

My enthusiasm was soon dampened, however, by persistent load problems. Neither the assembler manual nor any of the documentation that comes with a Level-1 machine mentions what the little "C" in the upper right-hand corner of the screen means. It did not take me long to correctly guess that it stands for "checksum error." Since the assembler tape only comes in "Level-2 format" (named file convention, 500 baud). Level-2 users are forced to first load the "system tape" using the "CLOAD" command. This program will then allow the loading of any tape written in Level-2 format, and furthermore will allow the user to specify the starting address.

I found that the "system" tape (written at 250 baud) never gave any load problems, but that the assembler tape (written at 500 baud) frequently did, and would sometimes load incorrectly 2 out of 3 times! I played around with level settings (3½ worked best), cleaned the heads, and tried both sides of the tape (to see if one side was a "bad" copy), all to no avail. What was worse, sometimes even a "good" load (no "C" on the screen) would result in screwy assembler operation (it would reject legal opcodes as illegal, or the assembler option "NL" would be permanent, etc.).

This points up the fact that even a checksum type of error checking does not catch all load errors, only those that alter the checksum (it is possible for two errors to cancel out).

This problem got so bad that my software development was at a standstill, and I was seriously considering returning my TRS-80 to Radio Shack with a live grenade taped to the side. The solution is so simple, and works so well, that I had to share it.

The trick is simple. You merely load the assembler, then dump it out again at 250 baud in Level-1 format. This tape can then be loaded with the "CLOAD" command, thus eliminating the need for the "system" tape. But more importantly, this virtually eliminates the load error problem (due to the fact that you will be loading at the lower baud rate). Here are the steps:

1. Load your assembler in the conventional manner.
2. Type in the simple assembler program "COPYA" reproduced below.
3. Assemble "COPYA" and dump it to tape with the file name "COPYA".
4. Return to BASIC (issue the "B" command).
5. Load the "system" tape.
6. Load the assembler by typing "EDTASM". (Repeat this step, if necessary, until a good load — no "C" — is obtained.)
7. Load the program "COPYA" you just assembled by typing "COPYA".
8. Put a new, good quality tape in your recorder and put it in record mode.
9. Type "/28672" (this is the starting address for "COPYA").

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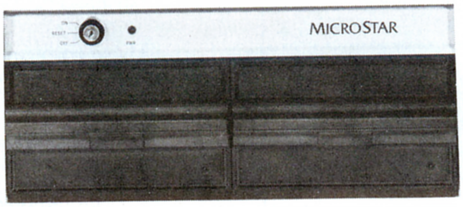

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CIRCLE INQUIRY NO. 16

"COPYA" will now dump out the assembler onto your tape, and when through, will return to BASIC. This gives you a 250 baud assembler tape, loadable with the "CLOAD" command.

GOOD NEWS, BAD NEWS

First, the good news:

1. You will not need the "system" tape to load your assembler anymore.
2. You can use "COPYA" by simply modifying the lower and upper bound addresses, to copy your own assembler programs to 250 baud, Level-1 format, so that they, too, can be loaded without the "system" tape (those of you who wish to share your assembler programs with non-assembler users will definitely need this).
3. Your load error worries are over: my 250 baud tape has yet to give me a bad load (used at least 100 times).

Now, the bad news:

1. Since you are loading at 250 baud, the loading process will take longer. I timed it at 5^m, 26^s. However, this is not too bad, as I also timed the conventional method, and including the time to change cassettes, reset volume levels, etc., the time was 4^m, 00^s.☐

"COPYA"

```
        ORG   41FEH      ;location of transfer address
ASSMA   DEFW  468AH      ;starting address of assembler
        ORG   7000H
CTON    EQU   0FE9H      ;cassette turn-on routine
CSAVE   EQU   0F4BH      ;cassette dump routine
BASIC   EQU   0000H      ;basic starting address
COPYA   CALL  CTON       ;turn on cassette
        LD    HL,4000H   ;set lower bound
        LD    DE,6800H   ;set upper bound
        CALL  CSAVE      ;dump to tape
        JP    BASIC      ;return to system
        END
```

CORRECTIONS

A command was misprinted in a July, 1978 article entitled "CP/M: An 8080 Disk Operating System" by Alan Miller. The corrected section of the article is listed below.

LIBRARY FILES

You probably have sections of assembly language code that you frequently use, such as I/O routines and HEX-binary/binary-HEX conversions. These routines can be placed into a disk file of type .LIB and subsequently inserted into another file that is being edited. The command:

```
*R HEXBIN
```

copies the file HEXBIN.LIB form disk into the edit buffer, starting at the CP.

These corrections from the January issue of the NTS Mini Series, page 84, should also be noted:

Reads: $X_C = \frac{1}{2fc}$

Should read: $X_C = \frac{1}{2\pi fc}$

Reads: $Fr = \frac{1}{2\pi LC}$

Should read: $Fr = \frac{1}{2\pi\sqrt{LC}}$

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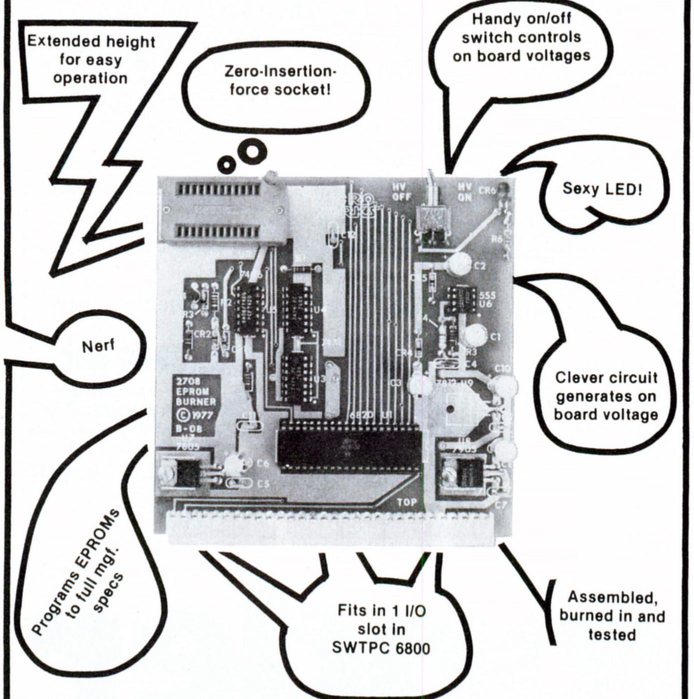
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CIRCLE INQUIRY NO. 11

R.H.D.

real handy data

By Robert H. Distler

DEFINING THE DATABASE

Last month I began offering some terms and general descriptions of a database. This month I will begin to define what will be in our database for the mailing list we wish to develop. For this discussion I will talk about the names of specific fields, the length of the fields and the interrelations the fields have. This is referred to as the *schema* or conceptual contents of the database and how each part interlinks.

The schema should not be confused with the physical layout of the data on the storage media. This is a function of the operating system, not the data base management system. The schema merely defines what makes up a given base, and the records that come together to form a file.

A *sub-schema,* on the other hand, is the definition applied by an application programmer to utilize the information held in the base as defined by the schema. Next month I will go into this interrelationship of the schema and sub-schema.

Before any discussion of a sub-schema can be entered upon, the base must be defined. That is our goal this month. You now know some of the terms that are important to understand and know that a maillist is to be developed. Right now our concern is what to put in the base, regardless of the type of machine involved or language to be used. BASIC will be used in our model, but at this point that is not important.

PICKING THE PARTS

A mailing list can consists of many different parts, depending upon what the user wants to do with the information contained in the information base. Ideally, a database should find use in more than one application and the schema should be defined in such a manner as to allow this flexibility for the application programmer.

Therefore, the following assumptions will be made concerning our theoretical mailing list database:

1. The primary purpose is to provide mailing labels
2. Each label will contain the following data:
    a. a six-digit customer number
    b. a fifteen-character customer name field
    c. a fifteen-character company name field
    d. a 20-character address field
    e. a fifteen-character city field
    f. a two-character state field
    g. a five-character zip code field
    h. a 12-character phone field
3. The list may be used later with accounts receivable.

From the information that we have listed, we know that we can derive a great deal of information about the customer. The customer number becomes an index item that can be used to further define the schema, that is expand it to contain more data, or to link another database that contains history on the company in question. Because we have defined a number of fields within a given record, we have provided a great deal of flexibility in the database for defining specific data for a particular application. For the mailing lists all fields will be used except the phone field.

Figure 1 is a representation of our schema for this database, showing how each item is interconnected, and the items that become the keys or index items for finding a particular record within the maillist file.

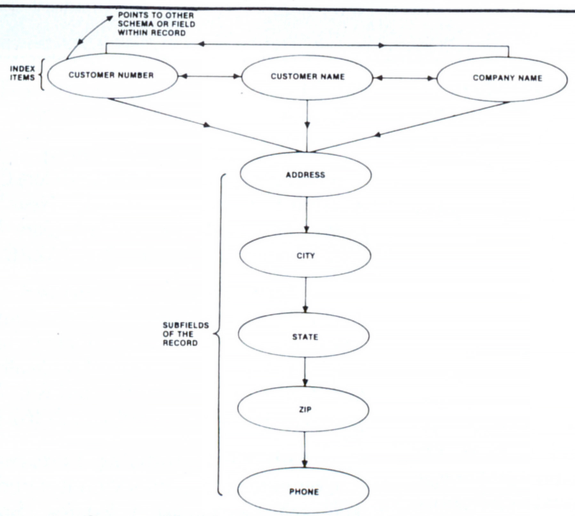

Figure 1. Generalized schema — organization — of mailing list database content.

Notice that three fields: customer number, name and company name are index items to the record, and are identified by the multiple arrows leaving them pointing to other fields in the record. The double arrow indicates that a field is a subset of another field and consequently intersection occurs.

The customer number field shows an arrow pointing out from itself and back again. This indicates a link either to expanded fields within the schema or to another defined database, which leaves a window open to us for later discussions.

UNDERSTANDING THE INDEX ITEM

Probably the most difficult concept in database design is to understand how an index item is used to locate a specific record and link all the parts together. To make this understandable, we will use the customer number index, since this is a unique number to any given record in a file.

From Figure 1, we see that for any given customer number there exists an intersection or pointer to other parts of the record. By the nature of the structure of the record, only those parts are associated with a given customer number. The idea is similar to a dog's tail, it must follow the dog's head in all cases. The same is true for an index item. All items that are associated with it must follow the item. In this case they are drawn into the application work area.

(Continued below)

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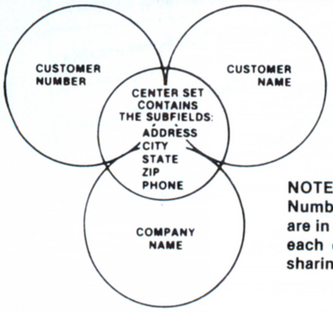

NOTE: The index items: Customer Number, Name and Company Name are in union with, but not exclusive to each other. While at the same time sharing the sub-field set.

Figure 2. Conceptual view of the intersection of parts of a record, and the link of index items to the sub-fields.

Figure 2 demonstrates how an index item points to the rest of the record, and moves the pointer to the start of the record for clarification. Notice that Figure 2 is similar in design to Figure 1. The record is viewed as a separate entity with each sub part of field making up the whole and liked together by a record attribute. A given record follows the associative law of mathematics in that each part or field is in union with the rest and so forth.

Because each record is an entity, the union of parts is created when the record is first constructed. Attributes are added to the record when items outside the original record are to be associated. These are the so-called pointers and will be discussed later as we build the next schema associated with the customer number.

Next month I will utilize the schema just developed and discuss the link to the operating system and the physical layout of the date on the media. Also the sub-schema to be used by the applications programmer will be introduced.☐

Atari Mails "Refund" Check

Atari Inc. has initiated an exciting direct mail "refund" promotion, the first of its kind in the consumer electronics industry, for its programmable video computer system.

The mailing, containing a $2 check, was sent about April 16, and was based on hundreds of thousands of warranty registrations for the video computer system. It is a real, negotiable bank check and can be applied any time before June 10, 1979, against the purchase of any of the 28 game program cartridges available for the video computer system. The retailer simply deposits the check with his daily receipts.

To increase consumer response and excitement, Atari is inviting video computer system owners to enter the Atari Personal Computer Contest. The official entry form is the $2 check, on the back of which the consumer answers three questions about the Atari-400 and Atari-800 personal computers. Winners will be determined by a random drawing from correctly answered and eligible responses. Prizes are Atari-400 and Atari-800 personal computer systems, and $100 Atari personal computer merchandise certificates.

A Micro-Controlled Typewriter

An electronic typewriter utilizing a Z-80 chip is being introduced by Olivetti. Two models, ET201 and ET221, are designed to bring electronics to the secretary, filling the gap between electric typewriters and wordprocessors.

The machines are the size of standard electrics, have have storage capacities to handle tabs and recall standardized chores such as contracts and letters. The typewriter will type unchanging sections in the proper place, stopping to allow the typist to insert names and specifics. It can also print letter closings or other constant sections automatically.

The ET201 and 221 use daisywheel printers and have no mechanical parts, replacing them with electronic modules. There are five available printing modes, including boldface and reverse (white on black). A 20-character display on the ET221 allows the typist to make corrections before the line is printed. The ET201 has a two-character display.

Cost for the microprocessor-controlled typewriters is under $2,000.

Address Correction

The new address of the Microcomputer Investors Association was printed erroneously in the March Update. The correct address is 902 Anderson Drive, Fredericksburg, VA 22401. The association is dedicated to aiding investors who want to use computers to aid in their financial deals. For more information about the non-profit organization, contact Jack Williams at the above address.

New Leader at Jade

Jade Computer Products, Inc. has announced that John Leeper has obtained controlling interest of Jade and will assume the position of president.

Leeper comes to Jade from Empire Industries, Inc. of Dallas, Texas. From October, 1976 to the present, he acted as founder and president of SD Systems, which is owned by Empire.

Begun in 1976, Jade Computer Products is a leading mail order distributor of personal computer products and has recently opened up a retail operation in the Southern California area.

Call For Medical Papers

Medinfo 80, the third international conference on computer technology in Medical Informatics, has issued a call for papers. Program session topics include clinical care, administrative and educational planning, research and available systems.

Persons wanting to submit papers should send the proposed topic of their article to Morris F. Collen, Kaiser Permanent Medical Care Program, 3700 Broadway, Oakland, CA 94611 before September 30.

Completed papers, which cannot exceed five pages, must be completed by December 10. The conference will be held in Tokyo September 29 to October 4, 1980.

Apple Club Forming

A new computer club, Apple Byters Corps, is being formed in the Buffalo, New York, area. For information contact Gary Weir, 225 Walton Dr., Snyder, NY 14226.

TRS-80 Society Formed

The Central Alabama TRS-80 Computer Society is up and running. Meetings are the 3rd Tuesday of each month. For details contact Walter Bray, 2073 Rexford Rd., Montgomery, AL 36116, (205) 272-3621.

Self-Merchandising Fixtures

Computerland Corporation is introducing two self-merchandising fixtures, SoftSpot and MainBrain, at several Computerland stores.

SoftSpot is a custom-designed, self-merchandising fixture offering programs for personal use in finance, time budgeting, education and the stock market. The fixture will assist customers in picking their software from major suppliers including Apple, Commodore, GRT and Personal Software.

MainBrain is a self-merchandising unit for educational media, books, and cassette and video tape courses from publishers including Sybex, Osborne & Associates and Hayden. MainBrain will have self-service instructions to assist customers in making their choices of multi-media products.

Call For Articles

Eurocon '80, the fourth annual conference on electronics held in Stuttgart, Germany, March 24-28, 1980, has issued a call for papers. The theme of the conference is "From Electronics to Micro-electronics, Trends and Applications." The conference language will be English.

Propsective authors are invited to submit 3 copies of an extended abstract (500 words) before July 31. Notification will come by October. Send abstracts to Prof. W.A. Kaiser, University of Stuttgart, Breitscheidstrabe 2, D-7000 Stuttgart 1, Germany.

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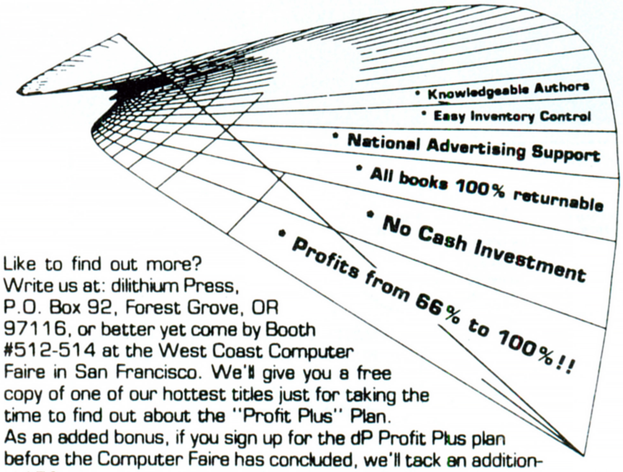
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New Sorcerer User's Group

Computer Mart of Massachusetts announces the formation of the Sorcerer User's Group. The purpose of the group is to set up a channel of communication between Sorcerer owners and to provide information on hardware and software developments to the Sorcerer user. Members will receive the User's Group's monthly newsletter, "The Exidy Monitor."

Membership fees are $5 a year, although new members will have the option of contributing a program in lieu of the fee. For details contact Bruce McGlothlin at Computer Mart of Massachusetts, Inc., 1395 Main St., Waltham, MA 02154, (617) 899-4540.

Thinker Toys Moves

Thinker Toys/Morrow's Micro-Stuff, manufacturer of S-100 products including the DISCUS I and 2D single and dual-density full-size floppy disk systems, announces its move from Berkeley to Richmond, California. The new facilities are significantly larger and will increase the production capacity of Thinker Toys. The address is 5221 Central Ave., Richmond, CA 94804. The phone number remains (415) 527-7548.

Microcomputers in S & L Industry

Financial institutions in Dallas, Houston and Denver are putting microcomputers to work performing specialized data processing tasks that large dp service bureaus are ignoring, according to Frank Hoffer, owner of Dallas-based S & L Systems.

Hoffer said the reason microcomputers have so readily penetrated an area that heretofore was the exclusive domain of the large dp systems is their low cost and appropriateness for special jobs.

The specialized tasks that are currently being performed on the 8080/Z-80 based S & L Systems installations include: escrow analysis; Federal Home Loan Mortgage Corporation reporting; amortization of deferred fees; loan warehousing and packaging; gain/loss on sale of participations; amortization schedules; cash flow models.

Hoffer said a system he recently installed for a mortgage banking client is used to prepare legal documents required in closing a mortgage loan. The system is used to generate the Settlement Statement, Regulation Z, Note, Deed of Trust and FNMA forms. Hoffer said "built-in" tracking of pending loans is featured.

Hayward Club Forming

A San Francisco area computer club, ABACUS (Apple Bay Area Computer User's Society) is currently seeking new members. The 40 charter members have established a library of over 200 programs. The club meets the 2nd Monday of each month at the Hayward Byte Shop, 1122 B St., Hayward, (415) 538-2431. For details contact David Wilkerson at (415) 482-4175. Membership is $12 a year, including a monthly newsletter.

Computer Mapping Library

A special six-volume Harvard Library of Computer Mapping, featuring selected case studies on computer mapping applications in business and politics, city, state and regional planning, natural resource management, and university instruction and research, will be published this spring by the Harvard Laboratory for Computer Graphics and Spatial Analysis.

The six volumes — *Management's Use of Maps; Commercial and Political Applications; Urban, Regional and State Applications* (plus a special section on Cadastral Systems); *Mapping Software and Cartographic Data Bases; Computer Mapping in Natural Resources and the Environment, Including Applications of Satellite-Derived Data; Computer Mapping in Education, Research and Medicine;* and *Thematic Map Design* — may be ordered directly by writing to The Harvard Library of Computer Mapping, Center for Management Research, 850 Boylston St., Chestnut Hill, MA 02167, or call Kathleen Quigley at (617) 738-5035.

Call For Articles

The International Society for Mini and Microcomputers (ISMM) will hold an international symposium on microcomputers and their applications in Monterey, California, January 30 to February 1, 1980.

Some topics which the symposium will highlight include technology, hardware, software engineering and applications in all fields.

Send three copies of camera-ready 200-word abstracts to

Secretary
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P.O. Box 2481, Anaheim, CA 92804

by September 1. Notification of acceptance will be sent by October 1. Camera-ready copy of accepted papers due December 15.

Proposals for half-day and one-day tutorials are solicited in the above areas and should be received by September 1.

Business Computer User's Survey

Management Information Corporation has published the results of their Fourth Annual Survey on small business computers, peripherals and software in the February 1979 issue of *Small Business Computer News.* The responses of 568 companies using 689 small business computer systems and 1,145 peripheral devices are included in this compilation. Also rated are the products of 124 software suppliers.

The results of the users' ratings reveal the following findings: service and manufacturer support have, once again, received the lowest ratings; although the equipment ratings for this year are substantially good, the software ratings are, in general, low; the computer marketplace now includes many unsophisticated small businesses with minimal data processing background; a significant increase of peripheral manufacturers made our winner's list this year over last year's survey winners.

This report is available for $7.50. To obtain a copy, send check or money order to Management Information Corp., 140 Barclay Center, Cherry Hill, NJ 08034.

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CHORAFAS SEMINAR

"Distributed Information Systems" will be the topic of two identical seminars scheduled for June, 1979 by Dr. Dimitris N. Chorafas, internationally-known management and data processing consultant.

The first will be held June 11-15 at the Radisson-Chicago Hotel, Chicago; the second June 18-22 at the Breckenridge Pavilion Hotel, St. Louis.

Topics will include new communications technologies; use of protocols and data bases; new software developments and applications.

Dr. Chorafas has operated a consulting business since 1961, advising company presidents, conducting seminars, and executive development programs for the American Management Association; IBM; Olivetti; Honeywell; General Electric; Shell Oil; ITT, UNIVAC and others.

For more information contact Richard A. Laubhan, Project Communications Inc., 333 E. Ontario, Suite 2603B, Chicago, IL 60611, (312) 266-2113.

CRYPTOGRAPHY SEMINAR

Ketron, Inc. is offering a seminar on "Implementing Cryptography in Data Processing and Communications Systems." These state-of-the-art tutorial presentations were developed by experts on the Data Encryption Standard and Public Key Cryptosystems. The two seminar leaders are Dr. Carl H. Meyer of IBM and Professor Ronald L. Rivest of MIT.

A Ketron spokesman describes this course as the most advanced training course now available to designers and managers of secure systems. This course should particularly appeal to systems designers who are responsible for planning privacy protection and access techniques for corporate databases.

The seminar will be held in New York City, May 14-16. The registration fee is $595. For information contact Larry Buchsbaum or Mary Jane Burns at (215) 687-6300.

TWO ADVANCED SEMINARS FROM POLYTECHNIC

Polytechnic Institute of New York and the Institute for Advanced Professional Studies are presenting two seminars. The first, directed by Dr. Hans Thamhain, is for program and project managers, product managers, R&D managers, and high-level executives in a multi-business environment.

The seminar, entitled "Managing Technical Programs and Projects: An Advanced Seminar," provides an advanced working knowledge of project management to professionals who plan, organize, and direct engineering projects for industrial, governmental or institutional organizations.

The session will be held May 15-17 at The Colonial Hilton Inn, Wakefield, Massachusetts. Tuition is $400.

The other seminar, directed by Dr. Glen Marston, is titled "Testing Microprocessor-Based Systems." The workshop enables design and test engineers to coordinate microprocessor-based product design with production testing.

The seminar will be held June 11-15 at The Colonial Hilton Inn, Wakefield, Massachusetts. Tuition is $495.

For details contact Prof. Donald D. French at (617) 964-1412 or the Institute for Advanced Professional Studies, One Gateway Ctr., Newton, MA 02158.

TWO BUSINESS SHOWS

Produx 2000, Inc. is sponsoring two shows in the Philadelphia Civic Center May 23-24. The shows, "Business Products and Environment Expo '79" and "Business and Personal Computer Sales Expo '79" will be open from 11 a.m. to 6 p.m.

For details contact George Pachter at (215) 457-2300.

WISCONSIN COMPUTER FAIR

The University of Wisconsin-Parkside Computer Fair III will be held June 2 from 9 a.m. to 4 p.m. Highlights of the fair include a computer solving contest for high school students, a seminar on the use of computers in Wisconsin's educational institutions with demonstrations, and a session on applying micros to the small business and professional office.

Admission is free. For details contact Don Piele, University of Wisconsin-Parkside Kenosha, WI 53141, (414) 553-2327.

COMPUTER STAMP EXHIBIT AT NCC

A Computer Stamp Exhibit, organized with the cooperation of the Computer Study Unit of the American Topical Association (ATA), will be held at the New York Hilton Hotel during the 1979 National Computer Conference, June 4-7 in New York City.

Collectors and organizations are invited to submit topical philatelic exhibits on the theme of computers and data processing. Related or more specialized themes, such as history of mathematics or data communications, also will be accepted.

Information and entry forms, including rules and regulations, are available from Dr. Ira W. Cotton, National Bureau of Standards, Washington, D.C. 20234; (301) 921-3517. Submit entry forms by May 15. There will be no charge for exhibiting.

Both competitive and non-competitive exhibits are solicited. Competitive exhibits, which may be entered only by individuals, will be judged in accordance with ATA procedures and will be eligible for prizes. Exhibits accepted for display must be sent, prepaid, to the NCC Exhibition Committee, c/o Dr. I. Cotton, Assoc. for Computing Machinery, 1133 Ave. of the Americas, NY, NY 10036 by May 31.

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Displays hexadecimal, ASCII, and symbolic instructions. Code reassembled using Editor/Assembler. REQUIRES: Level II

Monitor #3 $39.95
A machine language monitor program for the TRS-80. Available commands in Monitor #3 include: Find, Edit, Unload, Relocate, ASCII, Hex, and Symbolic Dump, Binary Math, Load, Punch, Identify, and Dump symbolic listing to cassette (will load into the EDITOR/ASSEMBLER for reassembly). REQUIRES: Level II, 16K RAM. Available on disk or cassette.

Memory Test $14.95
For Level II computers, 4K to 48K. Test ROM, RAM and video RAM.

Object Code Relocator $15.95
Designed to relocate machine language programs that were written too far down in memory to be used with Radio Shack's disk drive system. This program permanently moves most of Radio Shack's machine language programs into higher area of memory, thus enabling the program to reside in memory along with DOS and DISK BASIC. The user does not have to reload the relocated program each time it is used as it can be permanently moved high enough to escape the disk system.

16K Star Trek $10.95
A real-time Star Trek game for the TRS-80 written in machine language. Long range sensors display the Enterprise's position and objects in its adjacent quadrant at all times. Offers several features never incorporated in Star Trek games before.

Memory
16, 32 and 48K RAM Kits. Keyboard and Interface. Prices start at $99.95

779 Centronics Tractor Feed Printer
$1,100.00

701 Centronics Tractor Feed Printer
$1,549.95

SA-400 Shugart Disk Drives
Pertec Disk Drives
Each $399.00 — 2 for $785.00
Buy two, get cable free

19-Key Hex, Numerical Keypad
2 Version — $69.95
Programmable — $99.95

ALL HARDWARE WARRANTED FOR 90 DAYS

BUSINESS PROGRAMS

Data Base Management No. 1 $89.95
A complete DBM program. Employs five commands: Find, Add, Change, Video and Print. REQUIRES: Level II Disk Basic and one disk drive, 16K RAM.

Inventory for Very Small Business $49.95
Uses sequential files on disk to store inventory. Commands include: Check for item, Change item information, Add new items, and Print Inventory. REQUIRES: Level II Disk Basic and one disk drive, 16K RAM.

Medium Size Business Inventory $250.00
4,000 or more items. Complete and fully automatic, updates all files from one entry. Not junk! REQUIRES: 48K and 4 disk drives.

Cassette Duplication Programs $49.95
TAPERW TAPEWT
1 disk drive required. Allows easy and fast duplication of all cassette tape formats on I Level computer. Will duplicate Level I, Level II or machine language tapes.

NOTE: All programs on cassette unless noted. For disk, please specify and add $5.50 to order or send a diskette. All orders shipped same day. All programs guaranteed to RUN.

FINALLY, true CP/M disk operating system and all of MicroSoft CP/M-oriented programs available immediately for the TRS-80. Call or write for information and prices.

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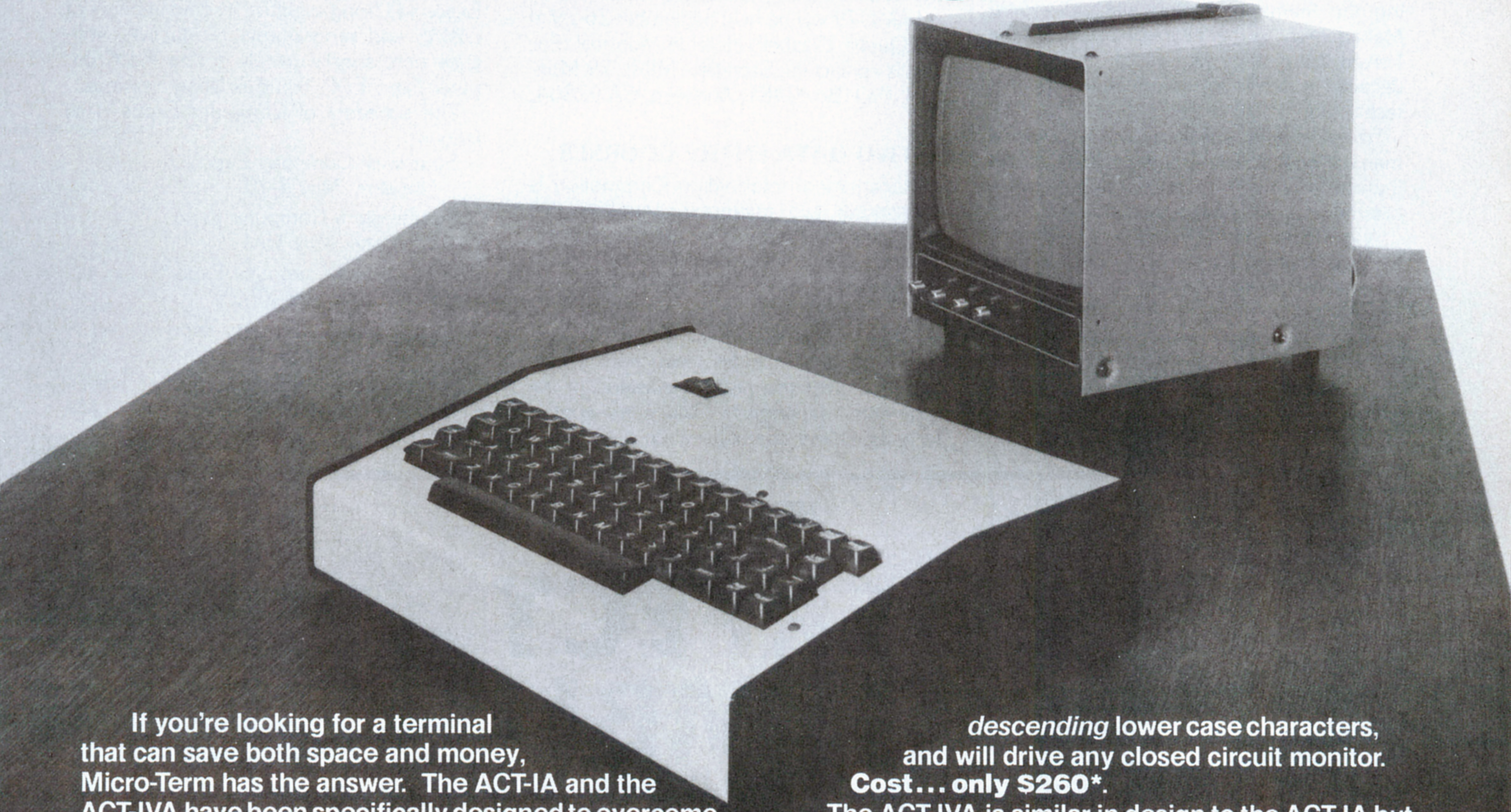
NASHVILLE, TENNESSEE 37214
MASTER CHARGE & VISA WELCOME

CIRCLE INQUIRY NO. 1

Information within arm's reach, without costing that arm... and a leg.



If you're looking for a terminal that can save both space and money, Micro-Term has the answer. The ACT-IA and the ACT-IVA have been specifically designed to overcome the problem of bulky computer terminals. Both terminals use external monitors with all electronics enclosed in an 11" x 14" keyboard. Light-weight, compact and portable, the ACT-IA and the ACT-IVA are perfect for offices where desk space is limited. They are also ideal for classroom instruction because each terminal can drive several monitors simultaneously.

The ACT-IA is a "dumb" terminal with a 16 x 64 display. Designed to replace the teletype, it is a fully electronic, silent terminal which can communicate with virtually any processor. The ACT-IA employs the standard RS232C interface with data rates from 110 to 19,200 baud. It will display upper and *descending* lower case characters, and will drive any closed circuit monitor. **Cost... only $260***.

The ACT-IVA is similar in design to the ACT-IA but includes some very important "smart" features, including insert and delete character and line, erase to end of line and screen, absolute cursor positioning, and block mode transmission. Complete with composite video output and a 24 x 80 display, the ACT-IVA has a standard, independent printer port for hard copy requirements. **Cost... only $525***.

So if you're looking for a terminal to fit both your desk and your budget, call or write Micro-Term today. We can put information within your reach.

All Micro-Term products are fully assembled, tested and have parts and labor warranted for 90 days. Sanyo monitors are available from $160.

*50 Quantity Price

CIRCLE INQUIRY NO. 32

MICRO-TERM, INC.

1314 Hanley Industrial Ct. • St. Louis, MO 63144 • 314-968-8151

REGIONAL DP CONFERENCE

The Sacramento Chapter of the Data Processing Management Association is hosting the Region 2 conference in Sacramento, California, June 10-12. The theme of the event is "A Technological Gateway to the Eighties." Tickets purchased before May 31 are $85 for members, $95 for non-members. For details contact Sam Price, Data Processing Management Association, P.O. Box 1223, Sacramento, CA 95806.

INFORMATION RESOURCE FORUM

The Society for Management Information Systems is holding a "Forum on Information Resource Management" at the Drake Hotel in Chicago on June 25-26. Addressing the theme of "Information Resource Management in the Years of Change," the Forum will provide an outlook for the next decade in terms of information systems technology.

Sessions and speakers will provide a management update in areas such as auditing and security, impact of distributed processing and data base management.

A key feature of the Forum will be an outlook panel of top MIS directors representing various industries who will present a perspective on the problems and potential of information resource management in their organizations and industries.

For details contact Ken Burroughs, DBD Systems, 1500 N. Beauregard St., Alexandria, VA 22311, (703) 820-3310.

HAMBURG HAMFEST

Ham Radio enthusiasts are invited to attend the seventh annual Hamfest at the Erie County Fairgrounds. The Ham-O-Rama, as it is known, will be two days long this year, beginning September 14. For details contact Francis Stengel, Jr., 349 Stony Rd., Lancaster, NY 14086.

MIMI MONTREAL

The International Society for Mini and Microcomputers is sponsoring a forum for the presentation and discussion of recent advances in the application of mini and microcomputers. The theme of the conference is "The Evolving Role of Minis and Micros within Distributed Processing."

MIMI '79 will be held September 26-29 at the Queen Elizabeth Hotel in Montreal. For details contact the Secretary, MIMI '79 Montreal, P.O. Box 2481, Anaheim, CA 92804.

TWO DATA ENTRY COURSES

Management Information Corporation is sponsoring two interactive seminars that deal with data entry. Discussions with instructors and other participants will provide solutions to problems that can be easily implemented.

"Data Entry Management and Supervision Seminar" includes instruction in data entry system concepts, organization of the data entry department, data entry control techniques and operator training.

MIC is holding the course at the Cherry Hill Inn in Cherry Hill, New Jersey on June 18-20.

The other course is entitled "The Data Entry Operator." The objective of this two-day interactive seminar is to make the data entry operators aware of their capabilities and motivate themselves towards reaching their own pre-set goals.

The seminar will also be held at the Cherry Hill Inn on May 22-23, 1979.

For registration fees and more information contact Management Information Corp., 140 Barclay Center, Cherry Hill, NJ 08034, (609) 428-1020.

EDP TREND BRIEFING SESSIONS

The 1979 Caravan group of Computer Expos will bring together leading vendors of DBMS and programmer productivity software onto special panels during the Computer Expo EDP Trend Briefing Sessions.

The schedule of Computer Expos is as follows:

Southwest Computer Expo
Houston, May 8-10

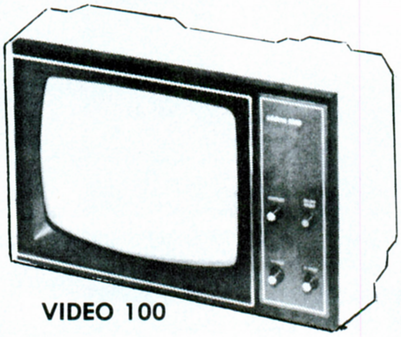
Southeastern Computer Expo
Charlotte, May 15-17

Northeastern Computer Expo
Pittsburgh, May 22-25

New England Computer Expo
Boston, May 29-31

Information is available from The Caravan Group, 60 Austin St., Newtonville, MA 02160, (800) 225-4260.

THE PERFECT COMBI-NATION



VIDEO 100

The Video 100 is designed to meet your monitor needs for both personal and business use. It is compatible with a wide range of computer systems, and with a band width of 12 MHz it is capable of displaying up to 80 characters per line on the 12" B/W CRT. The solid state circuitry assures a stable, & sharp display. The front panel controls include power, contrast, horizontal and vertical holds. Adjustments for height, vertical linearity, and width control are located on a rear panel. All the above features for only **$139**.

OE 1000
VIDEO TERMINAL

The OE 1000 Video Terminal provides you with a low cost means to communicate with your computer. The OE 1000 will display 16 lines of 64 characters on a monitor or modified TV. The terminal will generate and display the full 96 ASCII character set (upper and lower case) plus 32 special characters (Greek letters and math symbols). The terminal will also erase to end of line, erase to end of screen, scroll, and it has full X-Y cursor movement. Interfacing to your computer requires a full duplex, serial, RS 232 or 20 mA loop I/O port at the rate of 110 or 300 baud. The OE 1000 sells for **$350** assembled or **$275**. in kit form.

Master Charge, Visa, accepted. COD Extra.
Add $5 per unit, $10 both units, shipping handling insurance.

master charge

The perfect low cost combination of the OE 1000 and Video 100 are available from

VISA

OTTO ELECTRONICS

PO BOX 3066, PRINCETON, NJ. 08540 or call (609) 448-9165

CIRCLE INQUIRY NO. 40

TWO-DAY MANAGEMENT SEMINAR

The cash impact of manufacturing decisions is the focus of "Effective Production Planning and Inventory Management," a seminar presented by the Wharton School of the University of Pennsylvania on May 14-15 in San Francisco and June 25-26 in Chicago.

Designed for manufacturing organization executives, the seminar presents techniques to increase working capital, reduce inventories without compromising service, forecast market demands, resolve potential problems and minimize shortages and production delays.

For more information contact Heidi E. Kaplan, Department 20 NR, New York Management Center, 360 Lexington Avenue, New York, New York 10017, (212) 953-7262.

ICS OFFERS COURSES

Integrated Computer Systems, Inc. is offering 10 courses in a variety of cities in the U.S. and Canada. Classes run from one to five days.

Structured Programming will be held in Detroit, May 1-4; Washington, D.C., May 15-18; Chicago, June 5-8; Toronto, June 12-15; Hartford, June 19-22; and in San Francisco, Minneapolis and Ottawa in July.

The *Database Management Systems* course runs from May 8-11 in Washington, D.C.; May 15-18 in Los Angeles; July 10-13 in Toronto; July 31-August 3 in San Francisco and August 7-10 in Minneapolis.

Distributed Processing and Computer Networks will be held in St. Louis, May 1-4; San Francisco, May 8-11; Chicago, May 15-18; Toronto, June 5-8; Hartford, June 12-15; Washington, D.C., June 19-22; San Diego, July 10-13; Ottawa, July 17-20; and in Minneapolis, July 24-27.

A course in *Computer Graphics* will be held in Philadelphia, May 1-4; San Francisco, May 8-11; Seattle, May 15-18; St. Louis, June 5-8; Toronto, June 12-15; and in San Diego, Washington, D.C., Ottawa and Minneapolis in July.

Small Computing Systems will be held May 2-4 in Los Angeles; May 9-11 in Washington, D.C.; May 16-18 in Boston; June 6-8 in Toronto; July 25-27 in San Diego and August 1-3 in Ottawa.

Other courses available through the spring and summer months include *Troubleshooting Microprocessor-Based Systems, Modern Methods of Digital Signal Processing, Spread Spectrum Communication Systems, Microprocessor Hands-On Workshop* and *Military and Aerospace Microprocessor Systems.*

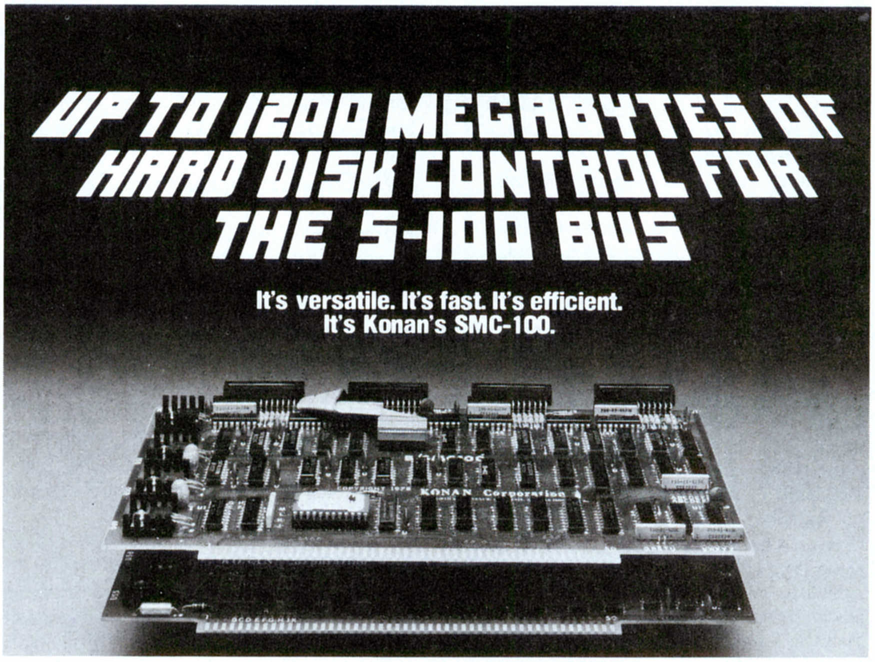
For more information about the courses, contact ICS at 3304 Pico Boulevard, P.O. Box 5339, Santa Monica, California 90405, phone (213) 450-2060 or at 300 N. Washington Street, Suite 103, Alexandria, Virginia 22314, phone (703) 548-1333.

ELECTRONICS PRODUCTION ENGINEERING SHOW

An international industrial exposition devoted to the needs of the manufacturers of electronic products in Korea has been announced by Clapp & Poliak, Inc., New York.

The exhibition, to be known as the Electronics Production Engineering Show, will take place this year at the Kosami Exhibition Center, in Seoul, November 5-8, and will be accompanied by an international conference with speakers drawn from the United States, Japan and Western Europe.

Further information is available from Expoconsul, the Clapp & Poliak international sales division, 420 Lexington Ave., New York, NY 10017.



UP TO 1200 MEGABYTES OF HARD DISK CONTROL FOR THE S-100 BUS

It's versatile. It's fast. It's efficient.
It's Konan's SMC-100.

The disk controller that brings S-100 bus micro computers together with large capacity hard disk drive.

Versatile.
It'll interface S-100 bus micro computers with all fixed or removable media disk drives with storage module (SMD) interfaces. These drives range from 10 to 300 megabytes per drive, including most "Winchester" type drives. Each Konan SMC-100 will control up to 4 drives . . . that's up to 1200 megabytes of hard disk per controller. And the SMC-100 lets you take your pick of hard disk drives (Control Data, Fujitsu, Microdata, Kennedy, Memorex, Ampex, and Calcomp, for example).

The SMC-100 works with your micro computer. It'll wait for your memory — it allows intermixing of slow and fast memories. It uses standard I/O instructions. And the optional driver ROM, addressed through descriptors, allows the SMC-100 to handle all disk interfacing, including error recovery and bad track mapping.

Fast.
The SMC-100 transfers data at high speed, 6 to 10 megahertz rates, with full onboard sector buffering and sector interleaving. Its DMA is considerably faster than most other S-100 DMA controllers.

Cost efficient.
The SMC-100 takes advantage of low cost-per-megabyte disk drive technology making the typical cost per megabyte about $100.

And the price is right.
The SMC-100 is a fast, efficient and versatile hard disk controller. It allows you to use low cost-per-megabyte technology. And, it's priced to keep your micro computer system micro-priced.

The O.E.M. single quantity price is only $1650, with driver ROM option. And excellent quantity discounts — and complete subsystems — are available.

Dave Baughman has the answers. Talk to him today. You can call him on Konan's order number: 602-269-2649. Or write him at Konan Corporation, 1434 N. 27th Avenue, Phoenix, Arizona, 85009.

KONAN

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CIRCLE INQUIRY NO. 26

APPLE SOFTWARE
at A-VIDD

DISK GENERAL LEDGER
Stores full sales and expense information on the Apple Disk. Searches are allowed on numerous fields in both sales and expense records. Monthly statement generation and expense, sales and general summaries are available.
Price on diskette **$60.00**

DISK CHECKBOOK REGISTER
Posting, listing, and reconciliation to the bank statement are included in the program. Complete check information is retained on the disk and searches on outstanding checks, specific date, payee, item or amount are possible. Several different accounts can be maintained on one disk. Program is also interactive with disk general ledger if need be.
Price on diskette **$35.00**

DATA BASE AND LABEL PRINTER
General data base program that also serves as a mini mailing list. Great for storing and retrieving any type of data to disk. All interaction with the program is done thru a 'menu'. You can add to files, list, print labels, search, clear files, and correct entries. Approximately 450 files per disk.
Price of diskette **$30.00**

DISK TEXT EDITOR
This is a line oriented text editor which supports up to 255 columns, adjustable margin, replacement of a specified string with another string, save text to disk, text may be in either upper or lower case, output text to printer and justify text.
Price on diskette **$60.00**

MAILING LIST
Mailing list is a professional mailing list program that allows you to create and maintain a mailing list of up to 500 names on a single diskette. You have the ability to print all of your list or any selected group of names by means of a code field associated with each name. Also the names are printed in zip code order so that you can take advantage of bundled mail discounts from the post office.
Price on diskette **$39.95**

FORM LETTER
This program allows you to use a letter created with the disk text editor and a mailing list created with the Mailing List Program to print personalized form letters. It features replacement of names, titles, addresses, etc... within the body of the letter. The same code selection process as in the mailing list program is available and the letters are also printed in zip code order.
Price on diskette **$29.95**

PLEASE ADD $2.50 FOR SHIPPING AND HANDLING

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(714) 821-0870**

Three blocks South of the San Diego Freeway in the Los Altos Center.

Hours:
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Fri 8:30 AM - 9:00 PM
Saturday 10:00 AM - 5:30 PM

B of A, VISA & Master Charge accepted.

CIRCLE INQUIRY NO. 5

SOFTWARE ENGINEERING TECHNOLOGY SEMINARS

Software Research Associates has scheduled Professional Development Seminars on seven topics in Software Engineering to be presented during May through June 1979 in San Francisco. The series is intended for both management and technical personnel involved in all phases of Software Engineering.

The series brings together a group of technical specialists in a uniform presentation format designed to answer deep technological questions of importance in contemporary system design and implementation. Additional presentations are planned for the Washington, D.C. area in the Fall, and Europe in 1980. Seminars included are:

Performance Enhancement Technology (17-18 May 1979, $425) by Domenico Ferrari, which focuses on techniques for increasing the performance of software systems.

Modern Software Engineering Tool Technology (24-25 May 1979, $425) by Edward Miller, surveying available software tools that can be used effectively in all phases of a software system's life cycle.

Software Metrics Technology (31 May-1 June 1979, $425) by Tom Gilb, which focuses on the new methods of measuring and quantifying software systems.

Software Reliability Technology (21-22 June 1979, $425) by Herbert Hecht, intended to address contemporary methods for assessing the actual reliability of any software system that is used in a critical situation.

Software Costing Methods (28-29 June 1979, $425) by Victor Schneider, an in-depth investigation into the latest technology for estimating costs associated with software design, development, testing and maintenance.

Registrations details are available from Software Research Associates, P.O. Box 2432, San Francisco, CA 94126, (415) 957-1441, Mrs. Jill Engelbrecht.

OFFICE TECHNOLOGY RESEARCH GROUP SETS SPRING MEETING

The Spring Meeting of the Office Technology Research Group will be held at the Hotel Del Coronado in San Diego, California from April 30 to May 2.

The Group is an international association of administrative executives interested in staying abreast of and planning for the use of Office of the Future technologies in their operations.

For additional information about the Group write on company stationery to Mr. John J. Connell, Executive Director, Office Technology Research Group, Box 65, Pasadena, CA 91102.

TELECOMMUNICATIONS SEMINAR

A seminar program, Telecommunications: Trends and Directions, designed to provide an in-depth briefing on the status of the telecommunications industry for members of the financial community has been scheduled for May 22-24 at Dunfey's Hyannis Resort at Hyannis, Massachusetts.

The Hyannis Seminar is sponsored by the Communications Division of the Electronic Industries Association. The purpose of the meeting is to bring in top level executives from the telecommunications industry for frank and open discussions describing the present status and future direction of their segment of this fast-changing industry.

For registration information contact Peter Bennett or Karen Settevig at (202) 457-4937.

CONFERENCE AND EXHIBIT ON SMALL COMPUTERS

The Clemson Conference on Small Computers, "Application for Business, Industry, Education, Medicine" will be held at Clemson University on May 23-24. The conference is for those interested in small computers but who have a wait-and-see attitude, as well as persons already involved with small systems. Applications to be discussed are business, industry, engineering, medicine, education, agriculture and even the home.

For registration information contact Continuing Engineering Education, Clemson University, Clemson, SC 29631. For details on applications to be discussed or equipment exhibits contact W.J. Barnett, Electrical & Computer Engineering Dept.

IEEE CHICAGO CONFERENCE ON CONSUMER ELECTRONICS

A special session on Teletext, Viewdata, and related Text-on-Television subjects is being organized for the 1979 Chicago Spring Conference on Consumer Electronics, which will take place on June 4 and 5 at the Arlington Park Hilton Hotel near Chicago's O'Hare Airport.

For information contact session organizer Dr. Walter S. Ciciora at (312) 391-8431.

NATIONAL SOFTWARE SHOW

Software Exhibitors, Ltd. has finalized plans for a national show called The Software Supermarket to be held in New York City on June 4-7, the same time as the National Computer Conference (NCC).

The show is at the Hotel Taft. For more information contact Lee Mulder, (312) 529-3518.

METRIC STANDARDS STRATEGY MEETING SCHEDULED

"Developing the U.S. Metric Standards Strategy" is the subject of a seminar to be held June 4-5 at the Sheraton O'Hare Motor Hotel in Chicago. The American National Standards Institute, which coordinates the development of voluntary national standards in the United States, is sponsoring the meeting.

Registration information is available from Claude H. Burns, deputy managing director, American National Standards Institute, 1430 Broadway, New York, NY 10018.

CONFERENCES ON COMPUTERS AND THE HUMANITIES

Two major international conferences are scheduled at Dartmouth College in 1979. The Fourth International Conference on Computers and the Humanities (ICCH/4) will be held August 20-23. The Conference on Data Bases in the Humanities and Social Sciences will follow on August 24-25.

ICCH/4 is the latest in a series held previously at the Universities of Minnesota, Southern California, and Waterloo, Ontario. It is sponsored by the Association for Computers and the Humanities.

There will be papers on the application of computers to research in language, literature, musicology, history, archaeology, and other related disciplines. Selected papers will be printed in "Computers and the Humanities."

Further information is available from Professor Joseph Raben, Queens College, Flushing, NY 11367, (212) 520-7407, 520-7428.

CALL FOR COMPUTER MUSICIANS

Due to the tremendous success of last year's computer music concert during the PC '78 show, the Philadelphia Area Computer Society is planning a full day conference on computer music which will include tutorials, demonstrations, product reviews, workshops, and seminars.

The conference will be held during one day of the PC '79 show in Philadelphia in October. The conference will be followed by the evening concert of computer music, to be held in a large auditorium nearby at the University of Pennsylvania. A professional recording will be made as it was last year.

If you are interested in participating in the concert or conference or would like a recording of last year's concert, write to: Computer Music Conference, Philadelphia Area Computer Society, Box 1954, Philadelphia, PA 19105.

ACM '79

The ACM 1979 Annual Conference will be held at the Plaza Hotel in Detroit, Michigan, October 29-31. The theme, "Advances of the 70's — Challenges of the 80's," focuses on the advances of the state of the art of computing during the past decade, the challenges that face computing in the next decade, and the transfer of computer technology from today's research to tomorrow's practice.

For more information contact Mayford L. Roark, Ford Motor Company, The American Road, Room 895 WHQ, Dearborn, MI 48121, (313) 323-1690.

COMPUTER GRAPHICS WEEK

Computer mapping and related software, hardware and data bases will be the subjects of a week-long international users' conference July 15-20, sponsored by the Harvard University Laboratory for Computer Graphics and Spatial Analysis.

Called Harvard Computer Graphics Week '79, the conference will be held in Cambridge, Massachusetts. The focus of this year's conference will be currently available cartographic and statistical data bases, graphics hardware, software, and the electronic communication of geographical information.

For details, contact Kathleen Quigley, Center for Management Research, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5035.

INTRODUCTION TO DIGITAL ELECTRONICS AND MICROCOMPUTER INTERFACING

This two week short course will be held July 16-27. It is a hands-on laboratory course for academic and industrial personnel. There will be one microcomputer laboratory station for each two participants. The course entails approximately 60 hours of laboratory instruction.

Reasonable living accommodations including free camping facilities. Tuition is $395. Academic credit is available.

For more information and application forms contact Professor Philip Peters, Department of Physics, Virginia Military Institute, Lexington, VA 24450.

UPCOMING SHOWS

Electronic Conventions, Inc. plans these 4-day shows:

Wescon/79 Show and Convention will be held September 18-20 at Brooks Hall and the St. Francis Hotel in San Francisco.

Midcon/79 Show and Convention will be held at O'Hare Exposition Center and the Hyatt Regency O'Hare on November 6-8.

For more information contact Electronic Conventions, Inc., 999 No. Sepulveda Blvd., El Segundo, CA 90245, (213) 772-2965.

AUSTRALIAN COMPUTER SHOW

Melbourne's first home computer show will be held December 9-10, 1979, at the Box Hill Town Hall on Whitehorse Road in Box Hill.

The show will be open from the hours of 10 A.M. to 10 P.M. on Sunday December 9, and 10 A.M. to 6 P.M. on Monday December 10.

The admission fee is $2. For more information about the show contact Australian Seminar Services Pty. Ltd., telephone (03) 267 4311.

6800 PRODUCTS at A-VIDD

SOFTWARE DYNAMICS EDIT

This powerful 6800 editor is written in the TECO style. It will work on either Miniflex, Flex V1.0, or V2.0.

Notable features include:

—Two input files, reselectable from EDIT
—One output file, reselectable from EDIT
—Multiple commands allowed on command lines
—Commands for both line and character editing
—Value registers
—Commands strings can be taken from a file
—Iteration commands for building custom editing commands
—Arithmetic, logicals, and relationals (<,<=,<> etc.)
—Labels for edit programming

Example:

```
[ [@>= '0&@<= '9^1M]
[@ = 32^1D] 9VL]
```

This example would scan an entire file and place a tab character in front of every line after the line number if any, and deleting all spaces at the beginning of each line.

Price **$100.00**

TECO® is a registered trademark of DEC.

Software Dynamics Compiler Basic for Flex including the MAL assembler and Run time package: **$329.00**

Dealer inquiries invited

6800 FORTH

Word oriented interactive compiler interpreter. Totally structured language where you define your own words and syntax.

On KC tape **$34.95**

6800 Hardware:

Smoke Signal 16K static memory board uses low power chip's for reliable service.

New low price **$299.00**

Microtime 6800

Plugs into any I/O port of the SWTPC 6800. Supplies user with time in hours, minutes, seconds, AM or PM, month, date and year. (ie: 5/1/79 12:00:00 PM PST.) Provisions for optional battery or external A/C power supply. Supplied with software to set time, interrogate clock and print time.

Assembled & Tested **$95.00**
Bare Board w/Documentation **$35.00**

A-VIDD electronics co.

2210 Bellflower Boulevard
Long Beach, CA 90815
(213) 598-0444
(714) 821-0870

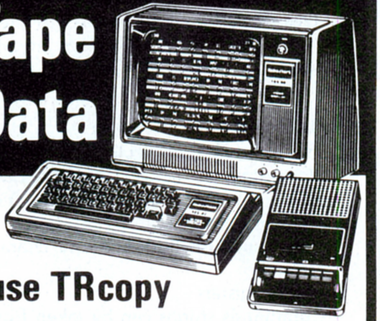
Three blocks South of the San Diego Freeway in the Los Altos Center.

Hours:
Mon - Thurs 8:30 AM - 5:30 PM
Fri 8:30 AM - 9:00 PM
Saturday 10:00 AM - 5:30 PM

B of A, VISA & Master Charge accepted.

CIRCLE INQUIRY NO. 6

See and Copy Tape Data



use TRcopy

WITH YOUR LEVEL II TRS-80*

TRcopy is a cassette tape copying system that lets you SEE what your computer is reading.

COPY ANY CASSETTE TAPE**

With the TRcopy system you can copy any TRS-80 Level II cassette tape whether it is coded in Basic or in machine language. You can also copy data created by programs and you can copy assembler listings.

YOU CAN SEE THE DATA

As the tape is being loaded, you can SEE the actual data byte-for-byte from the beginning to the end of the program. Up to 320 bytes are displayed at one time. ASCII characters are displayed on the first line and hexadecimal code is displayed on the following two lines. Data is displayed exactly as it is input including memory locations and check sums.

IDENTIFY PROGRAMS

With TRcopy you can identify programs on cassette tapes without written documentation because you can SEE the filename. If you forget to label a tape, you can use TRcopy to display the tape contents and identify the cassette.

VERIFY CASSETTE TAPES

With TRcopy you can verify both the original tape and the tape copies. You can make certain that your machine reads the original tape correctly and that it makes byte-for-byte copies. TRcopy also counts as it reads giving you the exact length of the data.

MAKE BACKUPS FOR YOUR PROGRAMS

Now you can make backup copies of your valuable programs. Many times a cassette that you make will load better than one that is mass produced. The original can then be kept as a backup in case the copy is damaged.

MAKE COPIES OF YOUR SOFTWARE

If you are in the software business you can use TRcopy to make tested copies of your programs for sales distribution. TRcopy produces machine language tapes that are more efficient than those produced by the assembler itself.

RECOVER FAULTY DATA

With TRcopy you can experiment with the volume and level controls and you can SEE what the computer is reading--even if your computer will not read the data through normal read instructions! In this way it is possible to read and copy faulty tapes by adjusting the volume control until you SEE that the data is input properly.

SIMPLE – FASCINATING – FUN

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CIRCLE INQUIRY NO. 15

FROM THE FOUNTAINHEAD

By Adam Osborne

In my February column, I asked readers to telephone me with comments regarding adequacy of business systems. I received plenty of responses.

Most callers commented on points I raised in my February column. Many of these comments were very significant. Jerry Gaynor, the Pertec Disk Products manager, called to discuss **Winchester disks.** He accurately pointed out that too many articles discussing Winchester disks neglect to mention that these are fixed disks, permanently sealed in an enclosure from which they cannot be removed without completely disassembling the disk unit. Thus, you cannot have a rack of Winchester disk packs. To back up a Winchester disk, you must either have an additional disk with a removable cartridge, which makes no sense since it costs more than the Winchester, or you must use floppy disks, which could become tedious.

Winchester disks will have capacities ranging from 10 million to 100 million bytes. Double-density, double-sided floppy disks will have a capacity of 1 million bytes each, which means that you will need anywhere from 10 to 100 diskettes to back up a single Winchester disk.

Jerry also suggested that keyboard manufacturers put a return key to the left of the numeric pad to accommodate operators who are used to adding machines.

Tom Buckler of Data Domain called to endorse my **warnings against overusing floppy disks.** Tom believes that many imaginative but inexperienced enthusiasts simply do not understand the importance of adequate hardware, and in particular, large disk capacities. I can only agree with Tom, especially when I see literature describing products such as the Nestar Systems Corporation "Cluster One." The "Cluster One" is a pair of floppy disk drives which, supposedly, is to be shared by a large number of microcomputers. True, Nestar is offering Cluster One as something less than full-blown time sharing, but in my opinion, it represents an unrealistic over-utilization of the limited capabilities provided by a pair of floppy disk drives.

Bud Johnson called from Montana, inquiring about the use of **Selectric typewriters as printout devices.** I have commented on Selectric typewriters in previous columns. Do not use Selectric typewriters as printout devices in any computer system of any kind. Mechanically, they are simply inadequate.

Michael Fungerolis from North Carolina, and Bill Jovert from Redlands, California, called to endorse the notes of caution in my column. Both agree that when you buy a microcomputer system, you should expect to get nothing other than what you can see, touch and use at the time of purchase. The only safe way to buy small microcomputer business systems is to assume that "what you see is what you get" and "what you cannot see does not exist."

I also got some calls naming **"good guys."** The Structured Systems Group of Oakland was praised for its software. Whatever they offer is good and reliable. Callers also had nice things to say about Vector Graphic and Cromemco hardware.

I do not know what will have become of **IMSAI** by the time this column appears in print. In late January and early February, IMSAI management met with their creditors to work out some method of continuing to operate. I sincerely hope that solutions are found, since the microcomputer industry does not need a "belly up," followed by a rush of nervous customers away from any computer with a new name.

It is easy to forget the large contribution that Bill Mallard, Joe Killian, Bruce Van Natta and Phil Reid made to the microcomputer industry. In my opinion, we have the IMSAI founders to thank for the degree of inter-product compatibility that exists today. In the early days, when MITS was a rising phenomenon, Bill took a chance and became the second major hardware manufacturer of the emerging microcomputer industry. He designed a product which, wherever possible, shared design characteristics with MITS. In particular, he used the MITS system bus, a de facto industry standard. Whether you are a supporter or a critic of the S-100 bus is not important. What is important is that the IMSAI founders had the foresight to value compatibility with somebody else's product over the intransigence of unique designs, which are the scourge of the minicomputer industry.

Helmar Herman of **Creative Computer Applications** sent me a description of his data management system, which is designed for the Micropolis floppy disk unit. Helmar's data management system appears to be simple, but sound. Those of you who are designing data processing applications around Micropolis floppy disks might save yourselves a lot of time by seeing what Creative Computer Applications has to offer you. They may be reached at (213) 265-6776.

Radio Shack has sold more than 100 million dollars worth of **TRS-80 computer equipment** in the first 18 months of selling this product.

A number of Japanese and American semiconductor manufacturers are now announcing **64K bit dynamic RAMs.** Inmos has been founded in Britain with a 64K bit dynamic RAM scheduled as one of its first products — presumably for delivery in 1981. But IBM has been manufacturing 64K bit dynamic RAMs, in volume, for almost two years. It is very fashionable to say unkind things about IBM, but I have to feel sorry for many of the superbly competent IBM engineers who pull off one design first after another, only to see their achievements ignored, or even slighted, by the technical press. ☐

JURISPRUDENT COMPUTERIST

By Elliott MacLennan
Attorney-at-Law

SOFTWARE PACKAGE CONTRACTS: PART II

In Part I of this topic, software was identified to be, from a legal standpoint, a unique intelligence transmission medium accompanied by a host of presently unsolved problems. It is because of this uniqueness that the software contractor as well as the user must clearly state in legal documentation just exactly what they have bargained for. One wants to either vend or purchase a software package without becoming a "test" case. Perhaps a simple way to state where the legal profession stands regarding computer related products would be to relate my own personal experience. In combing through legal digests and journals for material for this column, I have more often than not found computer related topics under the topic of "Automation."

Before delving into the specific contractual material on software packaging contracts, a short comment on a common problem I frequently encounter in reviewing what I shall generically label "computer contracts" is in order. Lawyers who do a lot of contract work prefer length to brevity. One might immediately suspect that this situation exists because lawyers, like their political cousins, are longwinded and feel that the longer the document the larger the fee.

But the more information that can be tied down and clarified the better. Litigation is directly related to ambiguities and failure to spell out important bargaining points.

But the more information that can be tied down and clarified the better. Litigation is. . . related to ambiguities and failure to spell out important bargaining points.

Besides ambiguity and omissions, the most frequent mistakes I see in non-lawyer drafted contracts are severe inconsistencies existing between contract clauses negating the intent of both clauses. Two contract clauses need not negate each other directly to cause a problem, they need only touch tangentially. Where a software package is licensed in return for a percentage of user's gross receipts, it is not uncommon to see the terms "net income," "sales proceeds" and "profit" all referring to the identical item. The result: an accountant's nightmare and a litigator's dream.

To be sure, those who market software may object to a long contract. I feel that a sales oriented input is mandatory to the legal draftsman to help him gauge language tradeoffs for creativity in marketing approach.

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CIRCLE INQUIRY NO. 22

I conclude my general comments on software contracts and now begin a discussion of the scope of financial terms in software contracts.

CHARGES BY TYPE

Every charge a user pays for the software should be defined and located in a single place in the contract. This prevents wrangling over hidden charges. The most frequently encountered charge is the cost of the package or the monthly license fee. Other charges might include taxes, user support, document reproduction, travel costs, and machine time necessary for the vending organization to test and install the system. If charges are stated in other parts of the contract, they should be cross-referenced to the main definitional paragraph.

PAYMENT TERMS

The timing of payments is critical to both vendor or user. From the user perspective, advance payments are undesirable unless collateralized by some product or deliverable. Alternately, the vendor must decide how to structure "progress" payments. Generally, it is better for the software organization to insist upon earlier payments in direct proportion to the degree of customization present in the package. For a standard package, however, a suggested payment schedule might be:

25%	upon delivery of a copy of the package and its supporting documentation.
25%	upon successful on-site installation and operation.
25%	upon user acceptance or not later than 30 days after installation.
25%	upon acceptance after expiration of the warranty or free maintenance period.

If the user makes advance progress payments he may be wise to place them in escrow pending package delivery. Some legal commentators have stressed user protection in package contracts predicated upon questionable financial responsibility of the software organization.

Nevertheless, if the user anticipates measurable loss due to nondelivery a money damage clause should be inserted. A specific amount or damage formula is prudent. This is known as a "liquidated damage clause." When it is reasonable in amount, it avoids the expensive necessity of "proving" damages. If it is unreasonable in amount, it may be classified as a penalty and stricken from the contract by a court of law. If no specific loss occasioned by nondelivery is foreseeable, a damage clause calling for 10% to 15% of the contract price will probably be held to be reasonable. It is obvious that a software vendor should disclaim, whenever possible, a nondelivery damage clause. This is especially critical where the vendor is pioneering a new or esoteric programming approach for a user's particular needs. The law is generally unforgiving when the cost of implementing a feasible technological innovation is commercially impractical or prohibitive, especially if vendor has contracted to produce the desired result.

PRICE PROTECTION ON LICENSE FEE AND OTHER CHARGES

If a license fee is renewable, it is desirable for both user and vendor to establish a renewal price or formula. The same is true of other charges like a maintenance fee due the vendor after expiration of the warranty period. This is especially important from the user perspective where his vendor alone is capable of providing the necessary maintenance.

Throughout this and the previous column I have been using the term "contract." It matters little what the name (or the lack of name) of the document is; it can be a short simple "businessman's" letter, or an "Agreement." What is important is whether or not a binding enforceable bargain is in effect.

Elliott MacLennan practices in the areas of business planning, taxation, and computer law. He can be contacted at:
Law Offices of Richard L. Carico, P.C.
745 Alcoa Building, One Maritime Plaza
San Francisco, CA 94111

The material presented in this column is intended for general information. The reader should seek competent professional advice prior to applying this material to a specific situation.

MICRO MEDICINE

By Wm. V. Weiss, M.D.
Professional Engineer

After a number of columns and some feedback from readers, it seems appropriate at this point to ramble a bit about recent comments and questions. The medical people have uniformly demonstrated a "learning-curve" complexion in their inquiries, confirming my opinion that there is a tremendous desire for greater familiarity with the "how" and "why" of data processing systems as well as with "what" kinds of applications are available. Although there is a natural interest in rationalization of system purchases on a "business-tool" basis, there is a clear desire by many health professionals to familiarize themselves with computers as a means of improving health care delivery.

Many physicians appear confused by the growing array of office systems for routine business functions, and many are awaiting the IBMs and DECs to get into the act with cheaper turnkey solutions to their accounting problems. Some have already committed themselves to service-bureaus for these functions.

There is no question the American physicians are moving into some kind of system in far greater numbers than their Canadian counterparts. The principal reason is that systems are 40% more expensive in Canada and the physicians earn on the average about one-half their American counterparts.

A number of physicians have expressed interest in applications of computers beyond accounting functions. I would recommend to those physicians with a working knowledge of data processing that *The Physicians' Microcomputer Report,* published by Dr. G.M. Orosz, is an excellent medium of exchange.

The professional computer people who have written in have posed more challenging "here and now" questions. I would like to touch on one area which was raised by Bernard P. Wess, Director, University of Maryland Computer Center. He outlined the value that data processing would bring to group practices: better and more accessible medical records, better local fiscal and personnel management, and finally, access to large central databases to improve the quality of care. These benefits are self-evident. The main problem is implementation and the main impediment is people.

First let us examine the prevalence of group practice. Is most health care today delivered in large groups, or even small groups? No. A "group" can be defined as a collection of health professionals in one or more locations with common files, common billing, and common income distribution.

If Canadian experience has any validity (being "socialized" we might expect more groups), true group practice is still in the minority. In Canada "group" practice accounts for approximately 25% of the physicians in practice. Of more interest is the breakdown of the size of groups within this figure. By far the most common group size is 3-5 professionals per group. I put group in quotes because many groups do not fit the definition and only share overhead and maybe records. Why so many words on the subject? As we move into the eighties, with nationalization of health care a probability, the current individualism and independence of most practitioners is often underestimated.

Canadian experience here is most important in order to get perspective as to priorities. Computers are used extensively by the government for payment of claims by large central agencies, but there are *no* terminals in any physicians' offices. We must recognize

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that when the systems (batch) were set up, cheap, small systems did not exist. It has been government policy (Canada, Britain, etc.) that extensive use of computers for other than accounting purposes was just too expensive.

If both Canadians and Americans could start from scratch with an ideal system, there is no question that centralized medical records (computer-accessible) would be cost-effecitve. But we have monstrous paper systems already established, and conversion will be astronomically expensive. As American health care moves towards some kind of national health system, the first priority is to provide access to care for all with assured payment for tests, hospital, physicians, etc. As inevitable cost rises (secondary to unlimited demand for service) occur, a vast national network looks more and more costly. The imposition of a utopian system on a highly individualized group of people seems unlikely at the moment; and yet, physicians are unlikely to produce their own computer solution due to unfamiliarity with computer networks and lack of coherent goals and motivation.

Dr. J. Maxmen, in his fascinating book "The Post Physician Era" (Wiley-Interscience Series), predicts that the "Medic-Computer Model" will be the successor to our current system by the early 2000s. This highly eloquent prognostication deserves more than passing mention because it is a very plausible consequence of the current developing trends. The cycle (bind) as I see it will become: I must utilize any technology which enhances my diagnostic and therapeutic effectiveness — the computer may (and probably will) do this — thus I am obliged to use it. In fact, as time goes on it may become "bad or malpractice" not to use computers in the provision of health care. Thus the implementation of Maxmen's "future" seems assured.

I believe this scenario deserves extensive discussion by both physicians and patients as we attempt to mold the future. Access to large amounts of medical information by the general public will change their dependence on physicians for advice. I predict that fairly soon, dialogues with a terminal will plan a patient's investigation and treatment. Physicians must be prepared to adapt to the possibility of "technological bypass" or credibility will start to fade. There are currently a few demonstration projects underway in North America in which the TV system will become a terminal dialogue system. As this spreads (and I believe it may be faster than the medical profession adopts computer technology), there may be a period in which people learn more about certain health problems than their physicians! No physician (or other health personnel), no matter how devoted to keeping up in his/her specialty or in medicine generally can keep up on all the new information pouring out of the research centers. Often a patient reads about a treatment his/her physician is not aware of.

How will the networks Mr. Wess has proposed come to pass? I would imagine there will be grants to several of the well-known academic medical centers to start the development of reference centers to which peripheral clinics can electronically refer on a regular basis, or perhaps some large media, or computer organization will take a chance on providing an information system that is attractive and cost-effective enough to attract subscribers. The most likely bet is that as "multimedia" two-way communication between remote terminal and central system becomes a fact of life, health-related material will just be added naturally. This is not very far away. Until then, individual physicians will experiment with local office or clinic systems which serve primarily an operational function rather than a reference or utopian function.

Clearly these events will not be precipitous, but the transition is happening faster than most knowledgeable observers would have anticipated. Recognizing the need for the discussion, the Faculty of Medicine at the University of Toronto is planning a Symposium next fall around the prediction and selection of several "FUTURES", based on technological trends and sociological and other nontechnical factors.□

The author can be contacted at Biolithics, 600 Sherbourne St., Suite 803, Toronto, Ontario, Canada M4X 1W4.

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THE MICRO-MATHEMATICIAN

By Dr. Alfred Adler

COMPLEX NUMBERS

Complex numbers are of great importance in practically every branch of applied science, but particularly so in electrical engineering. Phase relationships between signals or between voltage and current in circuits containing inductive or capacitive reactance are most easily represented by complex quantities.

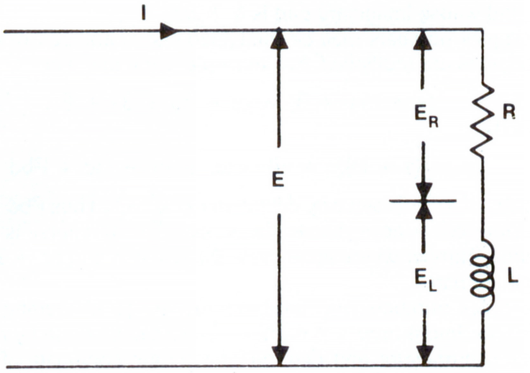

Figure 1. A series circuit containing inductive reactance.

Consider for example the circuit shown in Figure 1, where E is an AC signal. E_R, the voltage across R, is in phase with the current, I. But E_L, the voltage across L, leads by 90 dg. This can be represented by the vector diagram in Figure 2. The point P represents the sum of $E_R + E_L$, and has a magnitude E and a phase angle θ. Instead of carrying E_R and E_L as separate quantities and using cumbersome trigonometric manipulations, the vector E can be treated as an entity by the introduction of complex numbers.

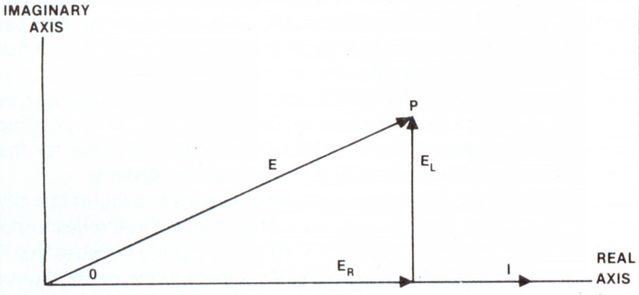

Figure 2. Vector diagram of a series circuit containing resistance and inductance.

A complex number is a quantity of the form $a + ib$, where a and b are real numbers and i is the square root of -1. The number a is called the real part and the number b is called the imaginary part. The reader should not be concerned that he cannot envision the square root of -1 in the real world, (neither can anyone else). Sufficient that he understand that it is a mathematical device whereby the imaginary part is rotated 90 dg. counterclockwise. In other words, any quantity that is multiplied by i has its phase angle advanced by 90 dg.

Referring back to Figure 2, we can represent E as the complex quantity $E_R + iE_L$. Note that the horizontal axis in Figure 2 is the real axis (the real part is plotted in this direction), and the vertical axis is

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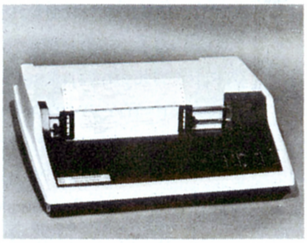

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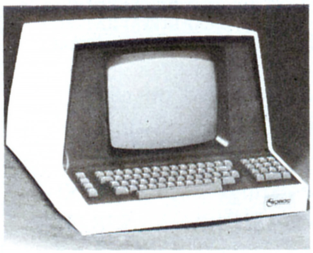

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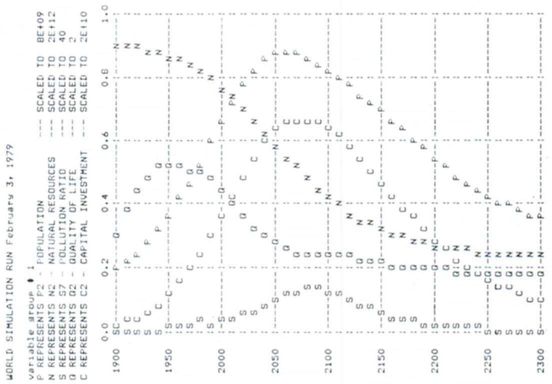
WORLD SIMULATION

by James L. Murphy, Ph.D.



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POPULATION
NAT RESOURC
POLLUTION RATIO
QUAL OF LIFE
CAP INVESTMENT
POLLUTION GENERATED
FOOD RATIO
LIFE EXPECTANCY
BIRTH RATE
CROWDING RATIO
MATERL STD OF LIV
NAT RESOURC USAGE
CAP INVEST RATIO
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the imaginary axis (the imaginary part is plotted vertically). Thus in a sense a complex number is a way to write two numbers as one, yet keep track of the two separate parts. The beauty of the mathematics of complex numbers is that during the manipulations the two parts become totally inseparable and yet when the manipulations are completed and the solution presents itself, everything sorts itself back out properly.

In the manipulation of complex numbers, addition and subtraction are rather straightforward, multiplication and division are a bit more involved, and powers and roots are somewhat more complicated. A computer program or subroutine that performs these manipulations is a real time saver. Such a program is presented later in this article.

Let us start by examining the details of these manipulations. First of all, complex numbers obey the ordinary rules of algebra; and second, a complex number equals zero only if both the real and the imaginary parts equal zero. These two rules are sufficient to enable us to define addition, subtraction, and multiplication. Complex numbers are added by simply adding the real parts to each other and adding the imaginary parts to each other, and similarly for subtraction. For example, let z equal the complex number $a + ib$, and let w equal the complex number $c + id$. Then

$$z + w = a + ib + c + id = a + c + i(b + d)$$

In other words, $z + w$ is a new complex number whose real part is $a + c$ and whose imaginary part is $b + d$.

Complex numbers may be multiplied just as any pair of two part expressions are multiplied. For example, we know that

$$(x + 2)(y + 3) = xy + 2y + 3x + 6$$

Similarly,

$$zw = (a + ib)(c + id) = ac + ibc + iad + i^2bd$$

Note that $i^2 = -1$, since by definition $i = \sqrt{-1}$. Thus $i^2bd = -bd$. Therefore $zw = ac - bd + i(bc + ad)$. This of course is another complex number where $ac - bd$ is the real part and $bc + ad$ is the imaginary part.

Complex numbers may easily be divided by converting the denominator into a pure real number. This may be done by multiplying both numerator and denominator by the conjugate of the denominator, that is, the denominator with the sign of the imaginary part reversed, as follows.

$$\frac{z}{w} = \frac{(a + ib)}{(c + id)} = \frac{(a + ib)(c - id)}{(c + id)(c - id)} = \frac{ac - bd + i(bc + ad)}{c^2 + d^2}$$

The process of converting the denominator into a pure real number by multiplying by the conjugate is called "rationalizing" the denominator. All that remains now is to divide both the real part and the imaginary part of the numerator by the real number $c^2 + d^2$. This presents no difficulty and the result will of course be another complex number.

In Figure 2 we gave a geometric interpretation to the complex number $E_R + iE_L$. In this interpretation we displayed the real part along the horizontal axis and the imaginary part along the vertical axis. Such a set of coordinates are referred to as rectangular or Cartesian coordinates. We added, subtracted, multiplied and divided complex numbers expressed in these coordinates. It is possible, however, to express complex numbers (or anything else for that matter) in many other sets of axes, or coordinate systems.

If we were asked, for example, to give directions to a tourist in a city, we might tell him to go four miles east and then three miles north. We would be using rectangular coordinates, mainly because that is the way most cities are laid out. But if we were in the open country we would be more likely to tell him to go five miles at an azimuth of 53.13 dg. (Azimuth is the angle clockwise from north). If instead of using azimuth we told him to go five miles at an angle 36.87 dg. north of east (that is, counterclockwise from east), we would be using polar coordinates. In the same manner, referring again to Figure 2, we could express the vector E in terms of its magnitude E and its phase angle θ.

The transformation from rectangular to polar coordinates may be made as follows. From the figure, $E_R = E\cos\theta$ and $E_L = E\sin\theta$. Thus $E_R + iE_L = E\cos\theta + iE\sin\theta = E(\cos\theta + i\sin\theta)$. By writing the series representations for $\cos\theta$ and for $\sin\theta$, multiplying the latter by i and adding, we obtain, interestingly enough, the series expansion for $e^{i\theta}$. In other words, $\cos\theta + i\sin\theta = e^{i\theta}$. This is known as Euler's formula.

Now what, the reader will ask, does it mean to take a number (*e*) to an imaginary power? That is a very good question, and it can be answered, but unfortunately not within the limits of this column. For the present, simply enjoy the fact that this representation makes taking powers and roots of complex numbers very easy. Note further that if $n\theta$ is substituted for θ in Euler's formula then $\cos n\theta + i\sin n\theta = e^{in\theta}$. Now from elementary algebra we know that $(x^n)^m = x^{nm}$. Therefore $(ax^n)^m = a^m x^{nm}$. From this it follows that $(Ee^{i\theta})^m = E^m e^{im\theta}$. Summing up, we have converted the rectangular coordinates E_R and E_L into polar coordinates E and θ by writing

$$E_R + iE_L = E(\cos\theta + i\sin\theta) = Ee^{i\theta}$$

We have then shown that we can obtain a power of a complex number by converting it to polar coordinates and then taking the magnitude of the vector to the power but multiplying the phase angle by the power index. Thus, suppose we have the complex number $z = 4 + 3i$. The magnitude of *z* is 5 and the phase angle is 36.87 dg. Thus the number may also be written $z = 5e^{i36.87dg.}$. To square this number we square the 5 and multiply by 36.87 dg. by 5. Therefore $z^2 = 25e^{i73.74dg.}$. Transforming this back to rectangular coordinates we obtain $z^2 = 25(\cos 73.74 + i\sin 73.74)$ which equals $6.99991 + i24.000025$. Noninteger powers are taken exactly the same way.

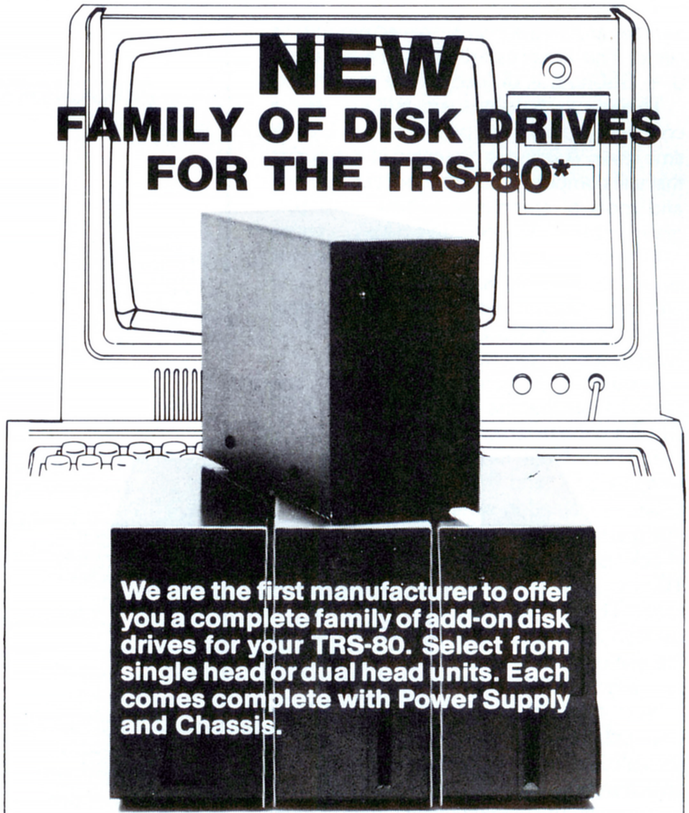
A root is really a fractional power, for example a cube root is simply the ⅓ power. Thus the above method for obtaining powers also obtains roots. However, it only obtains principal roots, not all the roots. This may be explained as follows. What is 2 to the second power? Obviously 4. But what is the second root of 4? Two is the principal root, but −2 is an additional root since −2 times −2 equals 4. As a more complex (no pun intended) example, what is the 4th root of 16? The principal root is 2 since $2^4 = 16$. An obvious additional root is −2, since $(-2)^4 = 16$, but there are still two additional roots.

It is a consequence of the fundamental theorem of algebra that if *m* is an integer, there are *m* values of an *mth* root, therefore there are 4 values of a 4th root. The problem may be looked at as follows. A 4th root of 16 is a 2nd root (square root) of a 2nd root of 16. The 2nd roots of 16 are 4 and −4. The 2nd roots of 4 are 2 and −2. We already have them. The two additional roots we are looking for are the 2nd roots of −4. Since −4 can be written as −1 times 4, the 2nd roots of −4 are the 2nd root of −1 times the 2nd roots of 4. The 2nd root of −1 is i by definition, therefore the 2nd roots of −4 are 2i and −2i.

Rather than use fractional powers to obtain roots, we might as well modify the system slightly so that we can pick up all additional roots at the same time. Just as we showed previously that $(Ee^{i\theta})^m = E^m e^{im\theta}$, similarly if we take a root (or fractional power), $(Ee^{i\theta})^{1/m} = E^{1/m} e^{i\theta/m}$. In other words, we can extract a root of a complex number by taking the root of the magnitude of the vector, but dividing the phase angle by the root index. Thus, using the same example as before, to take the square root of $z = 4 + 3i = 5e^{i36.87dg.}$ we take the square root of 5, but divide 36.87dg. by 2.

In polar coordinates we obtain $z^{1/2} = 2.23607e^{i(18.435dg.)}$. Transforming this back to rectangular coordinates we obtain $z^{1/2} = 2.23607(\cos 18.435 + i\sin 18.435) = 2.12132 + i.707109$ as the principal root. To obtain the additional roots we recognize that θ is an angle, and that $\theta = \theta + 360dg. = \theta + 2(360)dg. = \theta + n(360dg.)$, since each time we add 360dg. we are going around one more time. No matter how many times we go around the angle doesn't change. Therefore instead of writing $z = Ee^{i\theta}$ we can just as correctly write $z = Ee^{i(\theta + 360ndg.)}$. We use n = 0 to obtain the principal root and successively n = 1, 2, 3, etc. until we have obtained all the additional roots there are. For example, if we are taking a 4th root, n = 0 gives the principal root, and n = 1, 2, and 3 give the additional roots. If we continue and let n = 4, we get no additional roots, we simply repeat the ones we already have. The square roots of $z = 4 + 3i$, therefore are $2.23607e^{i(18.435dg.)}$ and $2.23607e^{i(36.87 + 360dg.)/2} = 2.23607e^{i(198.435dg.)}$.

The first is the principal root and has been transformed into rectangular coordinates above. The second is an additional root and, in rectangular coordinates, $= -2.12132 - i.707109$. Note that if these two roots are plotted in rectangular coordinates they will lie 180dg. apart. Square roots *always* come out this way. Cube roots *always* lie 120dg. apart; 4th roots *always* lie 90dg. apart and so forth. A rectangular coordinate plot of a complex number is called an Argand diagram, and on this diagram the roots of a complex



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number are always evenly spaced around the circle. This is necessarily so since the angle 0 + 360ndg. is divided by the root index.

These manipulations are tedious, and a computer program that performs them is a real time saver. A listing is presented of a program that will compute products, quotients, powers and roots of complex numbers. This program, written in PolyMorphic BASIC, version A00, gives not only the principal roots but all additional roots as well. In response to prompts, the user has only to state whether he wants a **PR**oduct, **Q**uotient, **P**ower, or **R**oot and then give the numerical values.

A series of sample outputs is also presented. Note that the quotients in samples 2 and 3 are the inverse of the product found in sample 1. Note further that the roots in samples 5, 7, and 9 are the inverses of the powers obtained in samples 4, 6, and 8. In this manner the program has been made to check itself. Sample output pairs 8/9 and 10/11 involve noninteger powers and roots. These present no difficulty when this method is used. Sample pair 10/11 shows the use of either a power or a root to obtain the same result.

Note that small inaccuracies (and large ones under proper circumstances) creep into the calculations. This is because a considerable number of manipulations must be performed with only eight digit accuracy. Under these rather limiting conditions, roundoff and truncation errors, if any, pile up rapidly.☐

For those who have specific questions regarding math functions and the computer, write to Dr. Alfred Adler, 10360 E. Flintlock Tr., Tucson, AZ 85715.

PROGRAM LISTING

```
1   REM****************************************************************
2   REM
3   REM********* P R O G R A M   C O M P L E X ****
4   REM
5   REM**************** VERSION 2.1 ***** MAY 1978 ***********
6   REM
7   REM*********** WRITTEN BY - ALFRED A. ADLER PHD ********
8   REM
10 INPUT "STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :",O$
15 IF O$="R" THEN 200
16 IF O$="P" THEN 100
17 IF O$="Q" THEN 70
20 INPUT "STATE FACTORS :R1,I1,R2,I2 :",R1,I1,R2,I2
25 R=R1*R2-I1*I2\I=R1*I2+I1*R2
30 !"PRODUCT : REAL = ",R,"; IMAG. = ",I
40 !\GOTO 10
70 INPUT1 "STATE NUMERATOR :R1,I1 ",R1,I1
75 INPUT " AND DENOMINATOR :R2,I2 ",R2,I2
78 D=R2^2+I2^2
80 R=(R1*R2+I1*I2)/D\I=(I1*R2-R1*I2)/D
85 !"QUOTIENT : REAL = ",R,"; IMAG. = ",I
90 !\GOTO 10
100 INPUT "STATE BASE :R1,I1 AND EXPONENT :N ",R1,I1,N
101 R9=R1^2+I1^2
102 IF R1=0 THEN IF I1>0 THEN T=1.5707963\GOTO 110
104 IF R1=0 THEN IF I1<0 THEN T=-1.5707963\GOTO 110
105 A=I1/R1\GOSUB 500
110 R=R9^(N/2)*COS(N*T)
112 I=R9^(N/2)*SIN(N*T)
115 !"POWER :REAL = ",R,"; IMAG. = ",I
120 !\GOTO 10
200 INPUT "STATE RADICAND :R1,I1 AND EXPONENT :N ",R1,I1,N
201 R9=R1^2+I1^2
202 IF R1=0 THEN IF I1>0 THEN T=1.5707963\GOTO 208
204 IF R1=0 THEN IF I1<0 THEN T=-1.5707963\GOTO 208
205 A=I1/R1\GOSUB 500
208 R8=R9^(1/2/N)
210 R=R8*COS(T/N)\I=R8*SIN(T/N)
215 !"PRINCIPAL ROOT :REAL = ",R,"; IMAG. = ",I
220 IF INT(N)<>N THEN !\GOTO 10
222 P=3.1415927
225 FOR J=1 TO N-1
230 R=R8*COS((T+2*P*J)/N)\I=R8*SIN((T+2*P*J)/N)
235 !"ADDITIONAL ROOTS :REAL = ",R,"; IMAG. = ",I
240 NEXT
245 !\GOTO 10
500 K=57.2957804\S=SGN(A)\Y1=ABS(A)\X1=1\O2=45/K
502 M=0
503 FOR U=1 TO 10\Q(U)=0\NEXT
505 M=M+1
510 T2=SIN(O2)/COS(O2)
515 X2=X1+Y1*T2\Y2=Y1-X1*T2
520 IF M=6 THEN Q(6)=1\GOTO 550
525 IF Y2<0 THEN O2=O2/10\GOTO 505
530 Q(M)=Q(M)+1
535 X1=X2\Y1=Y2\GOTO 515
550 R5=K*Y2/X2\O=R5
555 FOR J=1 TO M\O1=450/(10^J)*Q(J)\O=O+O1
560 NEXT
565 T=O*S/K
566 REM TO MOVE ANGLES INTO 2ND & 3RD QUADRANT IF R1<0
568 IF R1<0 THEN T=T+3.1415927
570 RETURN
>
>
```

SAMPLE RUN

```
>>RUN

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :PR
STATE FACTORS :R1,I1,R2,I2 :1,2,3,4
PRODUCT : REAL =  -5; IMAG. =  10

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :Q
STATE NUMERATOR :R1,I1 -5,10 AND DENOMINATOR :R2,I2 1,2
QUOTIENT : REAL =  3; IMAG. =  4

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :Q
STATE NUMERATOR :R1,I1 -5,10 AND DENOMINATOR :R2,I2 3,4
QUOTIENT : REAL =  1; IMAG. =  2

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :P
STATE BASE :R1,I1 AND EXPONENT :N 1,2,3
POWER :REAL =  -11; IMAG. =  -2

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :R
STATE RADICAND :R1,I1 AND EXPONENT :N -11,-2,3
PRINCIPAL ROOT :REAL =  1; IMAG. =  2
ADDITIONAL ROOTS :REAL =  -2.2320507; IMAG. =  -.1339749
ADDITIONAL ROOTS :REAL =  1.2320511; IMAG. =  -1.8660252

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :P
STATE BASE :R1,I1 AND EXPONENT :N 30,40,3
POWER :REAL =  -116999.99; IMAG. =  44000.011

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :R
STATE RADICAND :R1,I1 AND EXPONENT :N -116999.99,44000.011,3
PRINCIPAL ROOT :REAL =  30; IMAG. =  40
ADDITIONAL ROOTS :REAL =  -49.641015; IMAG. =  5.9807605
ADDITIONAL ROOTS :REAL =  19.641033; IMAG. =  -45.980755

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :P
STATE BASE :R1,I1 AND EXPONENT :N 3,4,2.71
POWER :REAL =  -63.397236; IMAG. =  46.090258

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :R
STATE RADICAND :R1,I1 AND EXPONENT :N -63.397236,46.090258,2.71
PRINCIPAL ROOT :REAL =  3; IMAG. =  4

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :P
STATE BASE :R1,I1 AND EXPONENT :N 1,2..25
POWER :REAL =  1.176301; IMAG. =  .33416247

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :R
STATE RADICAND :R1,I1 AND EXPONENT :N 1,2,4
PRINCIPAL ROOT :REAL =  1.176301; IMAG. =  .33416247
ADDITIONAL ROOTS :REAL =  -.3341625; IMAG. =  1.176301
ADDITIONAL ROOTS :REAL =  -1.176301; IMAG. =  -.33416273
ADDITIONAL ROOTS :REAL =  .33416273; IMAG. =  -1.176301

STATE PRODUCT, QUOTIENT, POWER, OR ROOT : PR,Q,P,R :
```

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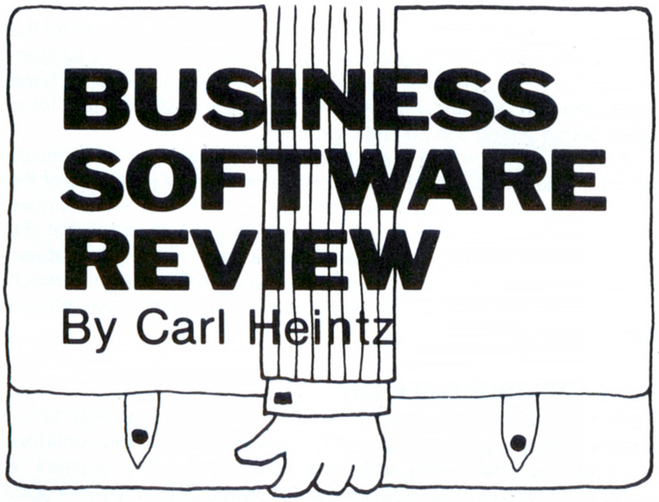

BUSINESS SOFTWARE REVIEW

By Carl Heintz

ACCOUNTS PAYABLE AND ACCOUNTS RECEIVABLE PACKAGE

This month we'll evaluate the Osborne & Associates programs, focusing on the Accounts Payable/Accounts Receivable package.

The Osborne programs, written by Lon Poole and Mary Borchers, come in the form of a book which includes lots of diagrams, flow charts, operator's tips and about 100 pages of program listings. The programs were written for a Wang computer and therefore utilize its unique form of BASIC. The authors realistically caution the reader that the programs should not be expected to be compatible to most machines, and that quite a bit of modification may be necessary. They are quite helpful in this regard, however, with a chapter devoted to the peculiarities of the Wang dialect.

The warning the authors issue, though, should be taken to heart by all but experienced programmers. Regardless of the explicit documentation, it will take one with some expertise in programming to wade through the pages of code and make all of the right changes. Don't fool yourself into believing you can make all the changes and put the program up on the new TRS-80 you just bought last week. It probably won't work, and will take weeks to debug.

OVERALL

The architecture of the overall system in the book is modular — to be expected and of course, needed in any microcomputer environment. In other words, instead of one large program, the author's system has a lot of little programs which are strung together and used to accomplish the tasks.

The central feature of the whole set of programs is the menu, which serves as an outline to all of the other programs. An unusual feature of the programs is that they combine accounts payable with accounts receivable into one package. The instant accountant's reaction will probably be confusion. After all, what does a receivable have in common with a payable?

The answer is logical. The authors have conveniently, and in a manner which saves a lot of disk space, used common sub-routines and utility programs for both accounts payable processing and the accounts receivable system. There are 35 common sub-routines which are shared amongst 21 programs and sub-programs, which means that a lot of storage space is saved.

There are 20 major programs in the system, utilizing 13 data files. Each of the files is nicely documented, with a number of options in file content left up to the user. All of the files are laid out in a hierarchical structure.

WHAT THE SYSTEM DOES

The accounts payable system in the Osborne book is a invoice-linked system, which means that everything revolves around the invoice. This is common among computerized systems and makes for a logical organization. As the book points out, the program "features a flexible check calculation procedure which allows you to calculate checks in one of two ways:you can choose a set of vendors and it will pay all their invoices and apply all their credit memos automatically, or you can list a specific invoice or credit memo combination for payment for specific vendors."

The programs even contain a program for printing the checks on check forms, and of course, the user can obtain an open or closed item listing plus an aging. By the way, the aging can be on a 30/60/90 day basis or any basis which is chosen by the user. And

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to top it off, the programs maintain a vendor activity total. Provisions have been made to post not only to the general ledger accounts but also to jobs, a feature which will prove very useful for those businesses which have a job shop.

The vendors on the accounts payable system are assigned a number, a feature which allows some fancy management information gathering. Some of the programs accumulate subtotals for groups of vendors. Thus it is possible, through judicious assignment of vendor numbers, to isolate activity by account or divisions. By using a different subtotal group prefix for each division's vendors, the spending patterns or various areas can be tracked.

The programs which involve the production of checks have a nice feature: The authors have precluded the possibility of producing a negative check. (This possibility can occur in many systems if the vendor's account has a negative balance.)

SOME PROBLEMS

While reviewing the programs, there appeared to be somewhat of a deficiency in the logic which is used to arrive at the check amount. Unfortunately, it's related to the "no negative checks" feature. The programs instruct the computer to methodically add up what is in the vendor file and if a credit memo has been entered in a manner so as to create a negative balance, the program ignores the resulting negative balance when computing the total. For example, look at the following two cases, and the different check amounts which would result:

$109	invoice	$109	invoice
200	invoice	200	invoice
–319	credit memo	50	invoice
50	invoice	–319	credit memo
Check calculated $50		Check calculated $40	

Note that in the first case, the programs added up $109 plus the $200 and then applied the $319. However, only $309 would be applied, so the $10 was left in the vendor file for future use. The program then added the $50 invoice, conveniently forgetting about the $10 credit which was lingering in the vendor file. This is a bit sloppy, and possibly could have been avoided with some sleight of hand programming finnesse. I must give the authors credit, though, for at least documenting the potential problem.

Another little glitch in the system is the ability to write duplicate checks. This could result in some problems with the recording of the cash disbursements and might provide a thief with an unlimited source of funds. The businessman should keep in mind that the fraudulent employee can always find a way to double-endorse checks over to himself. If the business owner isn't paying too much attention to the checks when he signs them, there is a real internal control weakness.

THE UNFORGIVABLE SIN

After studying the programs, I could find only one glaring, unforgivable deficiency. Based upon what I saw in the book and confirmed through my discussions with one of the authors, it appears as though the accounts payable transaction listing does not give a detail of the complete coding of all the invoices. Although each invoice's coding to the various accounts is shown, there is no summary of these amounts into one grand total, by account.

Apparently the system was designed to post directly to the general ledger files, without any hard-copy backup to indicate what accounts are debited and credit. The information is available for each of the invoices, on an individual basis, but no summary. Although the authors state that "audit trails" have been built into the system, one of the most basic of audit trails is apparently ignored.

When I discussed this matter with the authors of the program, the reason for the lack of backup became apparent. In the original configuration, the accounts payable package was interfaced with the general ledger package, which has a program designed to produce a hard copy journal. It probably would have been a better design to have incorporated such a program as an integral part of the accounts payable system itself.

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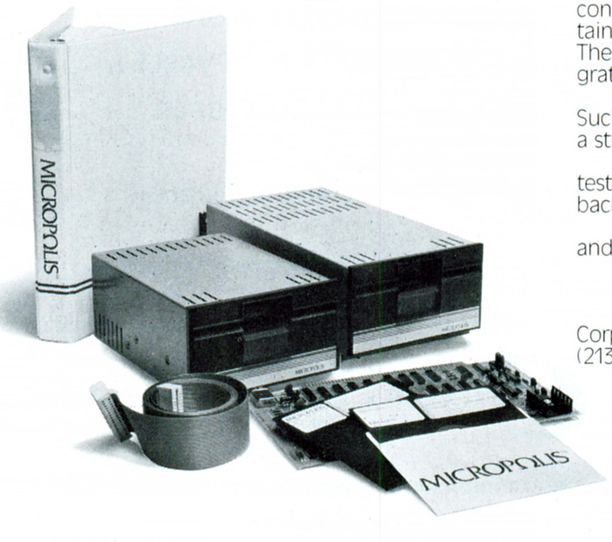

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The best of all possible systems, it would seem, should include the option of making several runs of the transaction register, where invoices are first entered, to insure that the entry process is free from errors. Then when the data is deemed to be correct, the operator should "post it" to the accounts payable files and the system should simultaneously produce a final transaction register. This register should contain all of the invoice detail, plus an indication of which accounts are affected. At the end of the run, a summary of amounts, by general ledger account, should be given. The designers of the Osborne system overlooked this crucial step because, in their system, the general ledger accounts were, apparently, affected by each of the invoices, thus showing the detail in each of the affected accounts. While this is laudable, nonetheless, a summary should appear on the final transaction run.

RECEIVABLES

The accounts receivable system is, like the payables system, organized around the invoice; it is the mirror image of the payable system. It should be pointed out that the design of the system is specifically for low-volume invoicing. Good planning went into the architecture of the system, with allowances made for the inputting of an invoice when it is ready for billing, after it has been billed and even after it has been paid. Partial payments on invoices are also included in the system. Provisions have been made for the production of customer statements and a number of management reports, including open invoices, aging analyses and the like.

One point of misconception may arise with respect to the receivables system. It does not function as an invoicing system. In other words, it will not generate invoices itself — it only generates statements, from invoices which are, presumably, created manually.

Just like the payables system, the first step in the receivables process is the entry of the invoices into the system. Entry of an invoice is different from the billing process, and this allows you to "run up a tab" for a customer. The system even allows you to enter progress payments before billing. There is a definite cycle of entering, listing, editing and correcting data which has been entered. Once data has been entered and has been listed (in a "transaction listing") and edited, it can be posted to the accounts receivable files. Unlike the payables program, on the transaction register there is a beautiful little summary of the detail data in the form of a journal entry which would please any accountant.

The basic output of the receivables program is the statement. The amount of data which is accounted for in the receivables files is impressive, and more than adequate to produce meaningful statments. Such information as type of sale, job number, descriptions, billing dates, tax codes, etc. are set up on the receivables files. The authors of the programs never apparently considered the problem of taxable and non-taxable items on the same invoice, however, since there are no provisions to handle this situation. The only way this problem can be circumvented is to enter each item individually. Another annoying feature is the inability to provide more than six spaces in which to describe what you are billing the customer for. More businesses need somewhat more flexibility than that — in addition to the description, some form of stock number should be included in the system.

OVERALL IMPRESSIONS

The overall impression which one gets upon careful review of the Osborne programs is that, despite their occasional flaws they are, without a doubt, an outstanding effort at a computerized payables/receivables system. The documentation is superb, and the amount of explanatory data is sufficient. The authors' concern with every aspect of the system is apparent.

While there are a number of areas in which improvements could be made, that can be said of every program to one degree or another. The programs in the Osborne book appear to be an excellent starting point for anyone wishing to design their own system, and should serve as an excellent benchmark by which to judge other systems.☐

Carl Heintz and Bob Johnson will be alternating as authors of this column. Software vendors who are interested in having their product reviewed can contact Carl Heintz at 2540 Huntington Dr., San Marino, CA 91108. Bob Johnson can be contacted at 7228 W. Reno St., Rt. 5, Oklahoma City, OK 73108.

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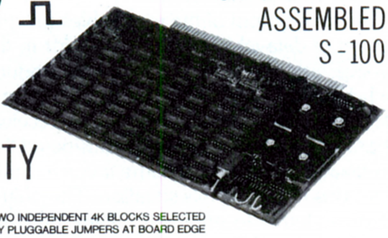

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INDUSTRY MEMO

Los Angeles area computer stores have been warned that unless they comply with a city ordinance requiring that all electrical devices sold in the city be certified for safety by either Underwriters Laboratories or the city, they will be forced to quit selling microcomputers.

Five stores inspected by the Los Angeles Department of Building and Safety early this year were found to be in violation of the ordinance. The fine for selling goods without the UL or local safety certification is $500 or six months in jail. The stores will be inspected three times before complaints against violators are turned over to the district attorney for prosecution.

Some store owners have taken the unauthorized equipment off their shelves. Others have decided to wait the city out, saying they would be forced out of business if they removed all the uncertified equipment, since very few microcomputer systems have the necessary labels.

"If you had the choice between closing your doors or saying 'we've got lawyers, let them handle this,' which would you choose?" Jim Collins, one of the principals of Computers Are Fun, said shortly after the inspection.

Collins said that he planned to wait until the second inspection before deciding how to handle the matter. Computers Are Fun handles only one brand, Ohio Scientific, that carries the required certification, he said.

> **"If you had the choice between closing your doors or saying 'we've got lawyers, let them handle this,' which would you choose?"**

Collins and many of the other store owners feel that it is up to the manufacturers to supply the certification for their products. If and when the city gets strict about enforcing the ordinance, store owners will have to take the unregistered equipment off their shelves.

"We'll ask the manufacturers to get the authorization," said Glenn Dollar of Rainbow Computing. "If Southern California is one-sixth of the computer market, they'll have to do something about it to keep us."

Most of the manufacturers contacted after the rule city's crackdown said they had applied with one of the agencies or planned to do so in the immediate future. The city will not prosecute companies that have certification pending. But if store owners are taken to court for violating the ordinance, the manufacturers of the illegal equipment are also charged, officials said.

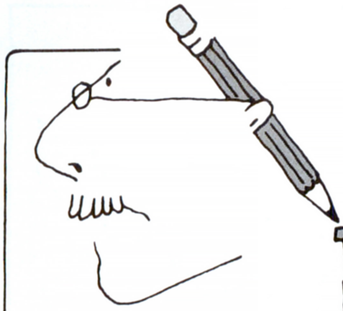
The cost of getting the labels varies. The city of Los Angeles charges by the number of hours actually spent doing the inspection of the equipment. Officials said that it generally takes four to six weeks to test the equipment.

Authorization by the nationally recognized Underwriters Laboratory costs considerably more, although a UL spokesman said the certification takes about the same amount of time. UL approval costs "from a few hundred to a few thousand dollars," officials say. The price is determined by the difficulty of the testing.

Although the UL label is seen on most appliances sold in department stores across the nation, officials say it is not unusual to find devices that do not carry the UL label. There are no nationwide laws requiring the certification, although many cities have ordinances like the Los Angeles law.

For those manufacturers that get the approval by either Underwriters or the city of Los Angeles, a new market will open up. Many government agencies will not purchase equipment that does not have some type of safety certification.

"The authorization helps not only from a legal standpoint, but also to get your product into schools, where they have requirements regarding the UL label," said Brett Bullington of Processor Tech.☐



THE INVENTOR'S SKETCHPAD

By Roger Garrett
Northeastern Regional Editor

A 3-D SYSTEM

I have been doing some work recently with a Vector General 3-D color display system. This is a fairly sophisticated piece of hardware that does a lot of the tedious tasks such as axis translation (offset) and rotation, perspective cueing (shrinking parts of objects that are far from the viewer) and depth cueing (reducing the brightness of far objects). This all provides for very nice displays and it has been interesting working with it.

But the Vector General does not address one of the basic problems in graphics; that of hidden line removal. This is the problem that occurs when displaying, say, one box in front of another. Assuming that the boxes are solid figures, then some parts of the second box, and, indeed, even the back side of the first box should not be visible on the screen.

The Vector General, which at best displays boxes as line figures, simply cannot handle this. The programmer has to take care of hidden line removal via software. The solutions are generally very time consuming and defeat the purpose of having high speed display generator hardware like the Vector General.

Well, I've thought of a solution.

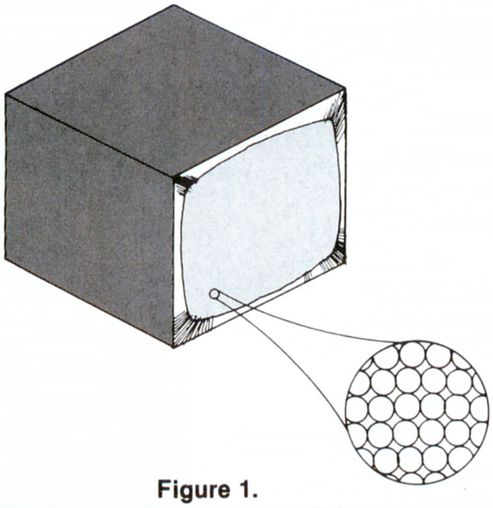


Figure 1.

FIGURE ONE

First of all we will use a raster scan CRT display. This way we can visualize our graphic picture as being comprised of individually addressable dots on the CRT. Each such dot is actually a *pixel*. Let's assume it is a matrix of 1024 pixels high by 1024 pixels wide (that's a total of 1,048,576 pixels). Each pixel can vary in brightness from maximum brightness to completely off, with fourteen shades in between. It can be any of sixteen different colors. In order to represent the status of any particular pixel we need eight bits (four bits for brightness and four bits for color).

FIGURE TWO

We set up a section of RAM memory with 1,048,576 bytes, one byte for each pixel, and build a *display refresh unit* which sequentially reads each byte from the *display memory*, translates it into intensity and color information and displays the resulting pixel at the appropriate spot on the CRT.

Since each byte in display memory corresponds to (maps into) a unique pixel on the CRT, we can display any picture by simply putting the appropriate intensity and color values into the appropriate bytes in the display memory. But that doesn't solve the hidden line problem.

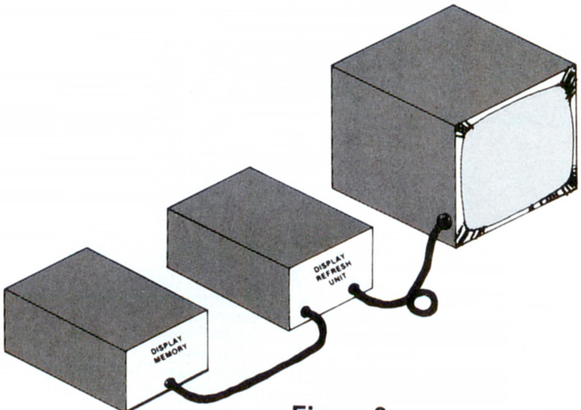


Figure 2.

FIGURE THREE

Consider what we are trying to draw — a *three-dimensional object*. Yet our CRT is only two dimensonal. We can specify the X and Y coordinates of a point on the screen and this data is inherent in the position (address) of the bytes within the display memory (i.e. each byte corresponds to a unique X,Y coordinate). But how do we specify the third dimension? If we look at our CRT, we can think of this third dimension as being the Z axis which points from the front surface of the CRT towards the back of the CRT. That's fine for conceptualizing it; how do we actually represent it?

With another section of memory which we will call the *depth value memory*. Each word of this memory will correspond to one byte of display memory and will hold the *depth value* for the corresponding pixel. Since the X and Y axis resolutions are each 1024, we will want the Z axis resolution to be 1024 also. So we need ten bits for each depth value word in the depth value memory.

Now the display refresh unit is not connected to the depth value memory unit. So what is the depth value memory used for?

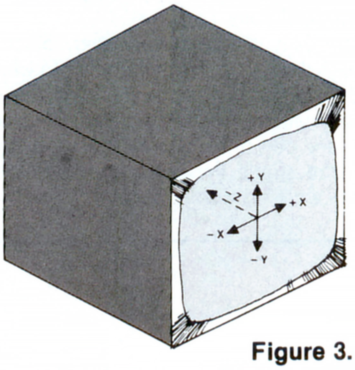


Figure 3.

FIGURE FOUR

Let's take a moment to consider what we are trying to display and how we might represent it in memory. Let's assume we are going to display some set of rectangular plates that are opaque (i.e. you can't see through them) and that these plates may be positioned anywhere and at any angle in our viewing area. The plates may even intersect each other. We are considering only rectangular plates because it is easiest to visualize this way. This discussion holds true for any type of object we wish to display.

We can represent any rectangle by specifying the X,Y and Z coordinates of any three of its corners along with its intensity (brightness) and color codes. There are other ways to represent it, but this will do just fine. We now set up some memory to hold the rectangle information, in the format shown, and we call this our *object data memory*.

			MEMORY WORD NUMBER
FIRST RECTANGLE	UPPER LEFT CORNER	X-COORDINATE	0
		Y-COORDINATE	1
		Z-COORDINATE	2
	LOWER RIGHT CORNER	X-COORDINATE	3
		Y-COORDINATE	4
		Z-COORDINATE	5
	LOWER LEFT CORNER	X-COORDINATE	6
		Y-COORDINATE	7
		Z-COORDINATE	10
		INTENSITY COLOR	11
SECOND RECTANGLE	UPPER LEFT CORNER	X-COORDINATE	12
		Y-COORDINATE	13
		Z-COORDINATE	14
	LOWER RIGHT CORNER	X-COORDINATE	15
		Y-COORDINATE	16
		Z-COORDINATE	17
	LOWER LEFT CORNER	X-COORDINATE	18
		Y-COORDINATE	19
		Z-COORDINATE	20
		INTENSITY COLOR	21
LAST RECTANGLE	UPPER LEFT CORNER	X-COORDINATE	n
		Y-COORDINATE	n + 1
		Z-COORDINATE	n + 2
	LOWER RIGHT CORNER	X-COORDINATE	n + 3
		Y-COORDINATE	n + 4
		Z-COORDINATE	n + 5
	LOWER LEFT CORNER	X-COORDINATE	n + 6
		Y-COORDINATE	n + 7
		Z-COORDINATE	n + 10
		INTENSITY COLOR	n + 11

Figure 4.

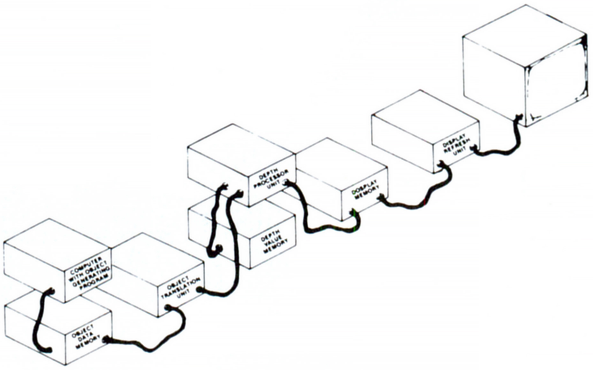

COMPUTER WITH OBJECT GENERATING PROGRAM
OBJECT DATA MEMORY
OBJECT TRANSLATION UNIT
DEPTH PROCESSOR UNIT
DEPTH VALUE MEMORY
DISPLAY MEMORY
DISPLAY REFRESH UNIT

Figure 6.

FIGURE FIVE

Next we need a device that will take the data for each rectangle represented in the object data memory, figure out what the corresponding two-dimensional projection of the rectangle should look like, and set the appropriate bytes in the display memory so that the rectangle will be displayed on the CRT. Remember, when you have a three-dimensional object and represent it on a two-dimensional surface, such as the front of the CRT, the resultant picture is a *projection* of the original object. Rectangles, unless they are perpendicular to the line of sight, will appear on the screen as shown on the CRT. It's this *object translation unit* which performs the projections from 3-space to 2-space.

Also note that it does not simply draw the edges of each rectangle. It fills in the rectangle with its specified color and brightness by determining which bytes in the display memory correspond to points within the projected rectangle and appropriately setting those bytes to the correct intensity and color codes.

There is a problem with this setup, however. Since the object translation unit displays the rectangles in the order in which they appear in the object data memory it will be necessary for us to make sure that the data starts with the object that is farthest away and continues sequentially to the object that is closest. As the object translation unit displays each rectangle, the displayed rectangle might overwrite data that already exists in display memory.

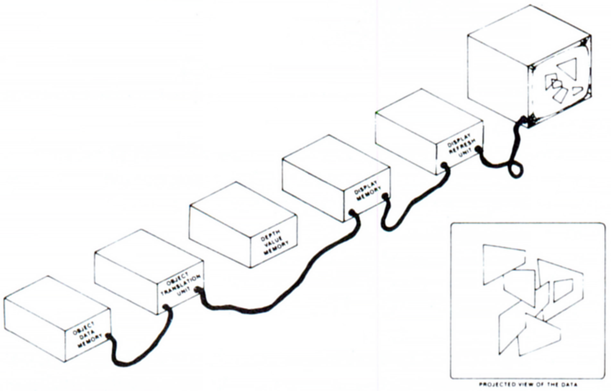

OBJECT DATA MEMORY
OBJECT TRANSLATION UNIT
DEPTH VALUE MEMORY
DISPLAY MEMORY
DISPLAY REFRESH UNIT
PROJECTED VIEW OF THE DATA

Figure 5.

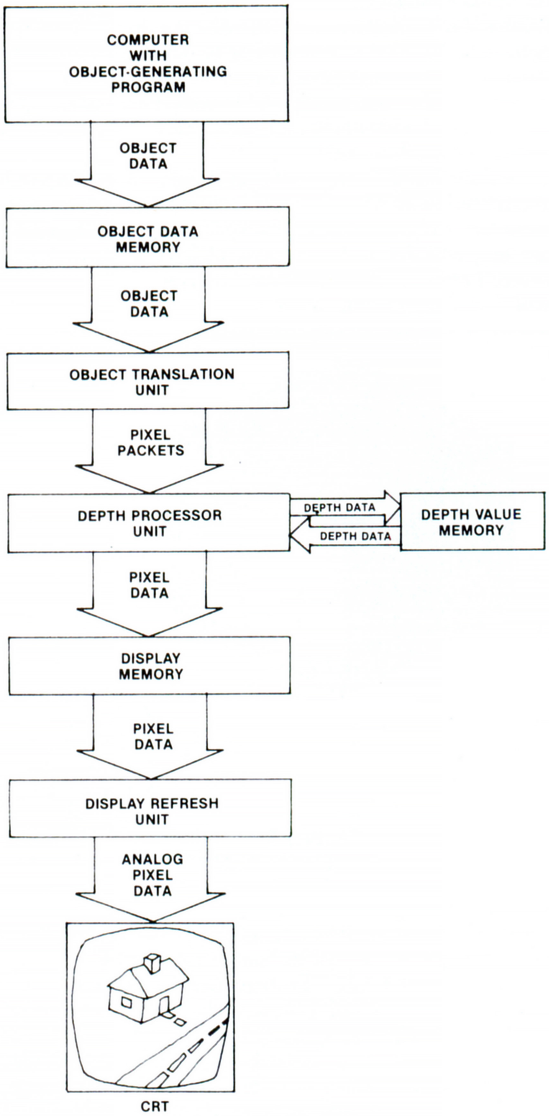

COMPUTER WITH OBJECT-GENERATING PROGRAM
OBJECT DATA
OBJECT DATA MEMORY
OBJECT DATA
OBJECT TRANSLATION UNIT
PIXEL PACKETS
DEPTH PROCESSOR UNIT
DEPTH DATA
DEPTH DATA
DEPTH VALUE MEMORY
PIXEL DATA
DISPLAY MEMORY
PIXEL DATA
DISPLAY REFRESH UNIT
ANALOG PIXEL DATA
CRT

Figure 7.

This means that an object that is far away might actually appear on the CRT in front of closer objects. The problem of determining which objects are closer or farther away and putting them in the correct order in object data memory is the problem we are trying to solve. We don't want to take the time to do this; we want to simply put our object data into object data memory in any order and have it displayed properly. Also, sorting them by closeness doesn't work when some objects intersect others.

FIGURE SIX

We now add a *depth processor unit* to the system in between the object translation unit and display memory and also connect it to the depth value memory. As the object translation unit processes each object it sends *packets* of information to the depth processor unit. Each packet tells which byte in display memory should be accessed and what its color and intensity should be and how far that displayed point is from the front of the CRT, i.e. what the *depth value* of that pixel is.

As the depth processor gets a packet, it first accesses the word in depth value memory that corresponds to the pixel that the packet is referencing. The value it gets from the depth value memory tells what the depth value is for the pixel that is already being displayed at the referenced point on the CRT. If the depth processor determines that the pixel described in the packet is closer to the front of the screen than the pixel already in display memory, it puts the packet's intensity and color data into the appropriate byte in display memory and puts the packet's depth value into the appropriate word in the depth value memory (i.e. it overwrites the existing data for the referenced pixel). If the packet's depth data indicates that it is behind the existing pixel, then the packet is ignored.

Believe it or not, that's it. You can put data into object data memory and everything will get displayed properly. Rather than operating on the data in an object-by-object basis, which is difficult and extremely time-consuming, we do it on a pixel-by-pixel basis which is simple and quick and can easily be done in hardware.

FIGURE SEVEN

Let's review what we have by following the data flow through our machine. We have a computer with a program that is generating *object data* in the form of rectangular plane information. This data is stored in no particular order (but in a known format) in the *object data memory* which, by the way, could easily be part of the computer's main memory.

The *object translation unit* picks up the data from the object data memory one rectangle at a time. It determines what the projected two-dimensional object for each rectangle should look like and which pixels must be accessed in order to display the image. It determines the depth value of each such pixel, based upon the size and orientation of the rectangle, forms *pixel packets* for each pixel (made up of the depth value, intensity and color codes, and two-dimensional coordinates), and sends the pixel packets one at a time to the *depth processor unit.* This unit takes each pixel packet, determines the depth value of the pixel currently displayed at the specified point on the CRT (by accessing *depth value memory*). If the pixel packet indicates its pixel is in front of the currently displayed pixel, then the depth value from the pixel packet is overwritten into the appropriate word in the depth value memory. The intensity and color data from the pixel packet is overwritten into the *display memory.* The *display refresh unit* then takes the pixel data from display memory (one byte for every point on the CRT), converts it to analog data for the CRT, and the picture is displayed.

A lot of work for the programmer? Of course not. All he has to do is write the program that generates the object data. Everything else is handled by the hardware to produce beautiful full-color three-dimensional projections. And the programmer doesn't have to worry about what objects he generates first. They will all be displayed correctly, even intersecting objects.

ONE FINAL NOTE

Display refresh is usually done thirty times a second with a short time between each refresh. In order to avoid flickering of the display it would be necessary to have the object translation unit and depth processor units complete their work *between* refreshes or, as an alternative, have a double-buffered display memory so the depth processor unit could be modifying one display memory while the display refresh unit is accessing the other. When this is done, your program could dynamically modify the contents of the object data memory, giving you a *moving* display.☐

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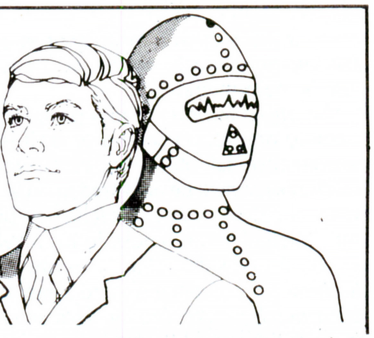
CIRCLE INQUIRY NO. 37

THE MIND REVOLUTION



By Merl Miller

Societies tend to develop both their technology and social institutions in a similar, parallel manner. This month I will give you an example of how this happens, comparing the histories of both machines and man.

The earliest machines were open-loop. This means there is no feedback and everything is accomplished by "brute force." A plow is a good example of an open-loop machine.

The only real change in machines has been the development of the closed-loop machine, which means the machine relies partially upon feedback. The first closed-loop machine was probably James Watt's stabilized feedback controller with a fly-ball governor.

The next significant step in feedback control was probably the invention of stabilized feedback amplifiers in radio circuits. These vacuum tube amplifiers were developed by Henry Black in about 1934. They ushered in the new era of modern closed-loop machines. Since then, a wide variety of these machines has been developed.

Some examples are: servomechanisms, broadband operational amplifiers, missile guidance systems, process control systems, etc. For the purpose of our discussion, and strictly for simplification, I will refer to these machines as robots.

The closed-loop machine, or robot, has a number of operational characteristics. First, it has a feedback loop. It *reflects* or, in other words, always compares what it gets with what it wants. It undertakes a *negative* process in its transactions and uses opposing forces to achieve its goal.

Through the transition from the open-loop to closed-loop machine, the machine has undergone a radical change of its "attitude," or "philosophy" of operating. We could say this *attitudinal revolution*[1] for machines began in the 1930's and its full potential is just starting to be realized.

If we examine history we will see that a similar attitudinal revolution has been occurring. During recent periods of modern history we have witnessed some significant changes in our social structure. Let's start by examining political institutions. In early history the political institutions were often dictatorial, centralized and despotic. Leaders ruled by brute force with little or no concern for the people.

As technology and society advanced it became increasingly difficult to maintain this system; so democratic forms of government began to emerge. These governments employ negotiative processes in their governance and allow opposing views in their process. They are sensitive to the needs of the people, much like a closed-loop system.

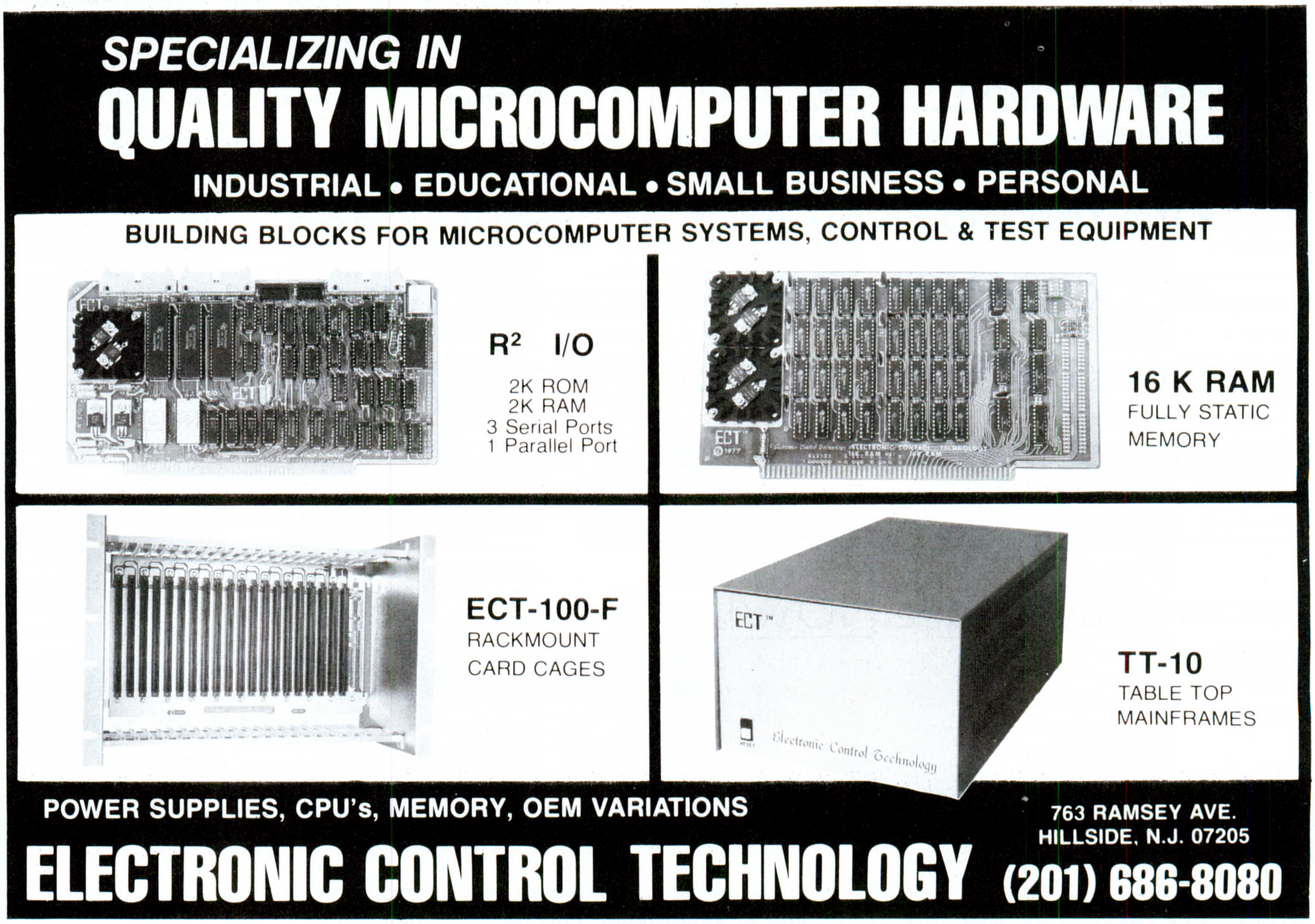
Taking this one step further, let's look at the change within industry. Early business and industrial organizations were often dominated, or solely controlled, by tycoons and moguls. These men were often eccentric millionaires. In business, they were praised for their strong leadership. This leadership often meant they ruled by brute force.

Modern business cannot function in this manner. Unions now dictate the workmen's rights and consumer groups grow stronger every day. Information about the market, sales data, public reaction to various products and impact of public users are all feedback that monitor the conduct of the firm, much like a closed-loop machine.

Are all of these structures changing from open-loop systems to closed-loop systems? Or does it just seem that way? ☐

---

[1] The term *attitudinal revolution* was coined by Dr. Wayne Chen, Dean of Engineering, University of Florida. Most of the ideas I am expressing here and next month comes from conversations with Dr. Chen and from a paper he prepared for a proposed book.



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BUSINESS EDITORIAL

By James Merritt

This article describes some of the strong points and the shortcomings of PASCAL, along with providing details about industry support for the new language. To respond to growing interest in PASCAL, INTERFACE AGE will begin a tutorial on the subject next month.

PASCAL IS HERE TO STAY

There are many, including a growing number of microcomputer manufacturers, who believe that PASCAL is one of the finest programming languages available today, and certainly deserves more than a cursory glance.

PASCAL is being added to the computer science curriculums of more and more colleges and universities all the time. Many of these institutions now teach PASCAL in introductory programming courses *in addition to,* and sometimes *instead of* BASIC or FORTRAN.

This academic acceptance is not a liability to PASCAL any more than it was for BASIC. Both PASCAL and BASIC were designed to be "teaching languages," intended to facilitate the education of computer science students while providing a convenient vehicle for laboratory assignments in programming.

But in contrast to BASIC, PASCAL was invested with considerable power at the start, along with a very regular grammar and vocabulary which makes it easy to explain and teach the use of even its most advanced features. The student of BASIC can "outgrow" the language in very short order. Anyone who has attempted to write a BASIC program of more than a hundred lines or so has probably experienced some of these "growing pains." Because of the simplicity of its design, PASCAL is suitable as a vehicle for introductory courses. However, due to its intrinsic power and affinity for large programs, PASCAL is also a facile tool for highly-advanced students and professional programmers. Therefore, it is no wonder that colleges and universities have embraced PASCAL in the 70's in much the same way as they welcomed BASIC in the 60's. Each, in its own time, has represented a positive breakthrough in computer education.

Colleges and universities are turning out more and more PASCAL programmers with every graduating class. Eventually, these individuals will exert enough pressure on the industry until PASCAL achieves the undeniable "respectability" which many imply BASIC has. Indeed, this process has already begun. Texas Instruments and Harris Data Communications, two giants in the industry, have demonstrated strong commitment to the language. Each uses PASCAL to develop software for internal use, and TI has even released a PASCAL compiler for its minicomputer line. Burroughs, another "big name," has begun placing want ads for systems programmers who will be responsible for developing PASCAL compilers, as well as language processors for "PASCAL-like" languages. The U.S. Department of Defense, the primary force behind the establishment of COBOL as a major programming language, is implementing a PASCAL-based language with which to standardize all internal system software.

In the beginning of the microcomputer industry, customers considered themselves lucky to have BASIC as a high-level language. Conventional wisdom held that small computers were, of necessity, limited devices, barely capable of running cost-efficient implementations of BASIC, much less any of the more advanced languages. Those who challenged that viewpoint were referred to the high-level language PL/M, developed by Intel for the 8080 and other microprocessors. Although powerful and convenient for writing programs, Intel's implementation of PL/M is not cost-effective for hobbyist or business applications because the compiler requires Intel's very expensive program development system as its environment. Until recent price drops in RAM and disk-storage devices, only a very few could afford just the hardware to support PL/M, not to mention the operating system software as well.

Observing the failure of PL/M to make inroads into the personal computing market, those who knew about PASCAL kept a low profile, either adhering to the line that PASCAL would be too complicated to implement for a micro, or believing that a successful implementation, while possible, would be too costly for the microcomputerist to afford until hardware prices went down. With hindsight, it is clear that this "wait and see" attitude, while fiscally responsible, only impeded the development of PASCAL, and served to strengthen the "chains" of popular attitude which bound microcomputers to BASIC.

Fortunately, some farsighted individuals, among them Dr. Kenneth L. Bowles of the University of California, San Diego, grew tired of hearing that it "couldn't be done," and acted instead to summon the future. Bowles and his group, in particular, achieved the previously unthinkable: simultaneous, practically identical implementations of "UCSD PASCAL" for a number of different microprocessors, such as the LSI-11, 6502, AM-100, TI-9900, and the 8080/8085/Z-80 family. In the space of a few short months, PASCAL for micros went from being a pipedream to a full-blown reality. Predictably, word of mouth carried the news to every part of the small-computer sphere, and the interest in PASCAL was ignited. It continues to increase today. Several major microcomputer manufacturers, including North Star Computers of Berkeley and Alpha Micro Systems of Irvine, California already support UCSD PASCAL.

Nobody should be rushed into choosing PASCAL as a programming language solely through fear of being "left behind." There is no question that BASIC will continue to be a major force in applications programming for small systems, if only because of the vast amount of software which has already been written in BASIC. Many commercial BASIC software packages are inexpensive, well-written, and eminently usable in the various applications areas they were designed to address. If you are already committed to a large amount of BASIC software, switching to PASCAL at this point can be an unwise move, since all of that software will probably have to be rewritten. For those in such situations, the old rule "don't change horses in midstream" makes a lot of sense.

On the other hand, if you are about to design and write a software system from scratch, or if your present software (in whatever language) is too limited to meet your present or future needs and you are considering a major system-rewrite and overhaul, I feel that you should seriously consider using PASCAL as your applications language. It has these advantages over BASIC:

- PASCAL source programs are COMPILED into memory-efficient, fast-executing object programs. Some compilers generate actual machine-code which may be executed directly by a microprocessor. The University of California at San Diego compiler generates "P-code." This is "machine-code" for a hypothetical processor called the "p-machine." The p-machine's advanced, stack-oriented architecture is ideally suited for executing PASCAL programs. The machine itself is simulated by a program written in the native machine-code of the host processor. The simulator executed the compiled p-code version of the PASCAL program. Even though p-code programs execute around 10 times slower when under simulator control than programs which are compiled directly into native code, this is still 5-12 times faster than equivalent programs written in most extended BASICs.
- In systems which use a p-machine simulator to execute the p-code emitted by the compiler, the simulator program itself is much smaller than the typical BASIC interpreter. UCSD's p-machine simulator, for example, requires only about 9K bytes of RAM at run-time, and will support compiled PASCAL programs which perform sophisticated disk-access, multiple-device I/O, string-manipulation, and other advanced computations. BASIC interpreters which allow similar programming power require anywhere from 12K to 16K of run-time RAM.
- Because of its superior program-structuring facilities, PASCAL makes it very easy to write large, complex programs as well as small ones. PASCAL promotes the breaking up of a complex task into smaller subtasks for which new PASCAL statements (procedures) and functions may be defined by the programmer.
- PASCAL variables may be given long, descriptive names so that the readability of the program and clarity of its intent are improved. This contrasts with BASIC's convention of using only single letters or single letters followed by single digits as variable names. Several implementors of modern dialects of BASIC has realized the value of long variable names in programs, and so permit them to be used. PASCAL has included this feature right from the start.

- At the programmer's option, variables may either be global or local to a given procedure or function. Global variables may be accessed at any point in the program. A change in a global variable at one point affects its value permanently for all other parts of the program. (In general, all variables in a BASIC program are global.) Local variables, however, exist only as long as the procedure or function which uses them is executing. Changes in local variables do not affect data used elsewhere in the program. Each time a procedure or function which uses local variables is called, a new set of local variables is created for its use. This particular characteristic of PASCAL permits the programmer to define *recursive* program segments — procedures and functions which *call themselves* in order to perform a given task or compute a certain value.
- To enhance program readability, constants may be given descriptive names. These names will be treated as synonyms for the declared constant value. For example, after the declaration

  ```
      const pi = 3.14159
  ```

  the name "pi" will be treated as if it actually is the number 3.14159 every time it occurs in the program text. Note that a constant is not a variable. In particular, no variable space is assigned to a constant name by the compiler — constant names are synonyms only. Readability is also promoted when *comments* are used in the program text. BASIC requires comments to be placed in special, separate REM statements. PASCAL allows the programmer to insert comments at any point in the text where a space may be used. (This does not apply, of course, to spaces within quoted string constants!)

  Comments must be surrounded either by the paid (* and *) or by the braces { and }. (Some implementations of PASCAL permit the use of both pairs, while others permit only one pair to denote comments.) Comments are ignored by the compiler, and do not transfer into the compiled object code. Thus, the programmer may comment a program liberally without affecting the size of the executable, compiled program.
- PASCAL programs are written in "free format." Line numbers are not required, as in most BASICs. Several statements may occur on one program line, or one long statement may continue over several lines, as long as quoted strings, other constants, and procedure, function, and variable names are not broken between lines. (The end of a line is treated as a space by the PASCAL compiler.) Most programming teachers recommend the use of indentation as an aid to program clarity, and PASCAL permits this in program text.
- Finally, PASCAL includes several advanced statements to control program looping and conditional execution. These special statements help obviate the need to use the GOTO statement in a PASCAL program. In BASIC and some other languages, GOTO must be used often. The excessive and thoughtless use of GOTO frequently leads to "spaghetti" programs, where the flow of control is so contorted that a major job of analysis is necessary to understand, trace, and debug even "simple" programs. PASCAL's special statements implement clear, straightforward control-flow, and help ease the analysis of a program's behavior. In the statement descriptions below, a "statement" may be either a single PASCAL statement or procedure, or a *compound statement.* A compound is a group of several PASCAL statements which are enclosed by the PASCAL keywords BEGIN and END. Each separate statement within a compound is terminated with a semi-colon, except for the last, which comes just before, and is terminated by, the END keyword. Compound statements are treated as single units during execution, much as expressions within parentheses are treated as single quantities when arithmetic expressions are evaluated. A control-flow statement, such as those below, may control a large program segment if this segment is expressed as a compound.

  LOOPING CONSTRUCTS

  ```
    WHILE condition (is true) DO statement
    REPEAT statement UNTIL condition (is true)
    FOR variable := initial value TO (DOWNTO) final value
      DO statement
  ```

  CONDITIONAL EXECUTION

  ```
    IF condition (is true) THEN statement (ELSE statement)
    CASE selector expression OF
      1st possible value: statement;
      2nd possible value: statement;
                    •
                    •
                    •
      last possible value: statement
    END;
  ```

  For the CASE statement, each of the possible values is a constant of the same type as the selector expression. Depending upon the value of the selector expression when the CASE statement is executed, the statement associated with the matching "possible value" will be executed, and all others in the case list will be ignored. Consider the statement:

  ```
    CASE ch OF
      'A': WRITELN('First case');
      'B': WRITELN('Second case');
      'C': WRITELN('Third case')
    END;
  ```

  If ch is a variable of type char, and the value it contains is 'B' when the above statement is executed, the following output will be produced:

  ```
    Second case
  ```

  BRANCHING — THE GOTO

  PASCAL's GOTO statement takes the following form:

  ```
    GOTO numeric label
  ```

  It causes an immediate branch to the first statement which occurs following the specified numeric label. Labels may be thought of as "line numbers," but are only required for a given statement in a program if it is desired to use a GOTO to transfer execution to that statement during program execution. The following program segment, when executed, results in an endless loop of greetings sent to the main terminal:

  ```
    1: writeln('HI THERE');
      goto 1;
  ```

  It is recommended that GOTO be employed only when use of the other statements would tend to obscure the meaning of a program rather than clarify it, or when it is necessary to jump to some remote part of the program (for example, in response to a detected error condition in program input for which special corrective action must be taken).

  Note that a statement such as BASIC's GOSUB is not necessary, since procedures are called by name, and the occurrence of a procedure name in a program is sufficient to call it.

All of these features, and more for which there's not space to examine, combine to make PASCAL a very efficient language in which to write programs. As a special bonus, PASCAL programs can be made very readable, if care is taken to use descriptive names for variables, procedures, functions, etc. To illustrate, one may combine the "polygon" procedure and "AnswerTo" function with a REPEAT statement, a suitably-named variable, and a new procedure, "AddOneTo(number)" to yield the following PASCAL program segment:

```
CurrentNumberOfSides := 2;
repeat
  AddOneTo(CurrentNumberOfSides);
  DrawRegularPolygonHaving(CurrentNumberOfSides)
until AnswerTo('Do you want to see more?') = No
```

Contrast this with its closest "standard BASIC" counterpart:

```
  10 S=2
  20 S=S+1
  30 GOSUB 1000
40 PRINT "Do you want to see more";
50 INPUT A$
50 IF A$ <> "NO" THEN 20
```

Neither segment is commented. Although comments are allowed in PASCAL, the listing above probably doesn't need them to be understood. On the other hand, the BASIC routine is very cryptic when no REMs are included to explain the purpose and function of the routine.

It should be noted that the special procedure "AddOneTo" is merely a concession to readability. That line could be replaced with:

```
CurrentNumberOfSides := CurrentNumberOfSides + 1;
```

Indeed, this assignment statement may be used to define the "AddOneTo" procedure. However, lines such as this and line 20 in the BASIC example above are often confusing to beginners, whereas "AddOneTo(CurrentNumberOfSides)" is likely to be quite clear.

Opponents are correct in stating that "there is nothing you can do in PASCAL that you can't do in BASIC." However, they fail to mention that if you program in PASCAL, the listing can be much easier to read, the resulting compiled program will execute faster (and, as a bonus, is also in a form which is hard to plagiarize), and that the increased power and bias toward program modularity which is built into PASCAL will help you finish writing and debugging your program much faster, on the average (especially for large programs), than the BASIC coder who attempts an equivalent program.

SOME DRAWBACKS

Today, "standard PASCAL" is accepted as being defined in the *PASCAL User Manual and Report* (N. Wirth, K. Kensen; Springer-Verlag: 1974). This language, upon which most existing PASCAL implementations are based, does not permit easy access to and manipulation of string data. Strings are defined as "packed arrays of char", but there are no procedures or functions for accessing substrings, searching for substring inclusion, concatenating strings, or determining the length of a string. While "standard PASCAL" includes most of the usual arithmetic operators, it doesn't support exponentiation. (The programmer may, however, write a procedure or function to achieve this. Indeed, the design philosophy of PASCAL was to provide a compact, spare language from which more complicated tools, such as exponentiation functions, could easily be built.) Random-access data files are not part of Jensen-Wirth PASCAL, not is interfacing to machine-language subroutines. "Standard PASCAL" has no pseudo-random number generating function. GOTO labels, when used, must be integer numbers — this is no better than BASIC (although it is perhaps a reasonable restriction, because GOTO and statement labels are needed so infrequently when writing PASCAL programs).

Most industrial implementations of PASCAL include extensions designed to solve most of these problems. For example, UCSD's version permits full string manipulation, a built-in function to substitute for the exponentiation operator, provisions for random-access of data files, and interface-linking between PASCAL object code and machine-language routines. PASCAL standards committees, including the group set up by the International Standards Organization (ISO) are now at work, formulating a new official standard PASCAL which will address the problems mentioned above as well as many others, and will probably validate the necessary extensions which industrial implementors have seen fit to make.

PASCAL software designed to exploit the inherent portability of PASCAL programs in general and that of those written in UCSD PASCAL in particular, is being written at this time by many concerns. Very soon, a reasonable variety of applications software will be available for PASCAL systems, and it will not longer be necessary to program PASCAL applications "from scratch."

Here are some sources for further information:

International PASCAL Users' Group
Attention: Andy Mickel
University Computer Center: 227 EX
University of Minnesota
208 SE Union Street
Minneapolis, MN 55455

Institute for Information Systems
Attention: Dr. Kenneth L. Bowles
Mail Code C-021
University of California
La Jolla, CA 92093
Phone (714) 452-4526
(For information about UCSD PASCAL)

Manufacturers supporting PASCAL at this time:

Alpha Micro Systems
17881 Sky Park North
Irvine, CA 92714
Phone (714) 957-1404

Altos Computer Systems
2378B Walsh Avenue
Santa Clara, CA 95050
Phone (408) 244-5766

Apple Computer
10260 Bandley Drive
Cupertino, CA 95014
Phone (408) 996-1010

Marinchip Systems
16 Saint Jude Road
Mill Valley, CA
Phone (415) 383-1545

North Star Computers
Attn: PASCAL Working Group
2547 Ninth Street
Berkeley, CA 94710
Phone (415) 549-0858

Northwest Microcomputer Systems
121 East Eleventh
Eugene, OR 97401
Phone (503) 485-0626

Western Digital
3218 Redhill Avenue
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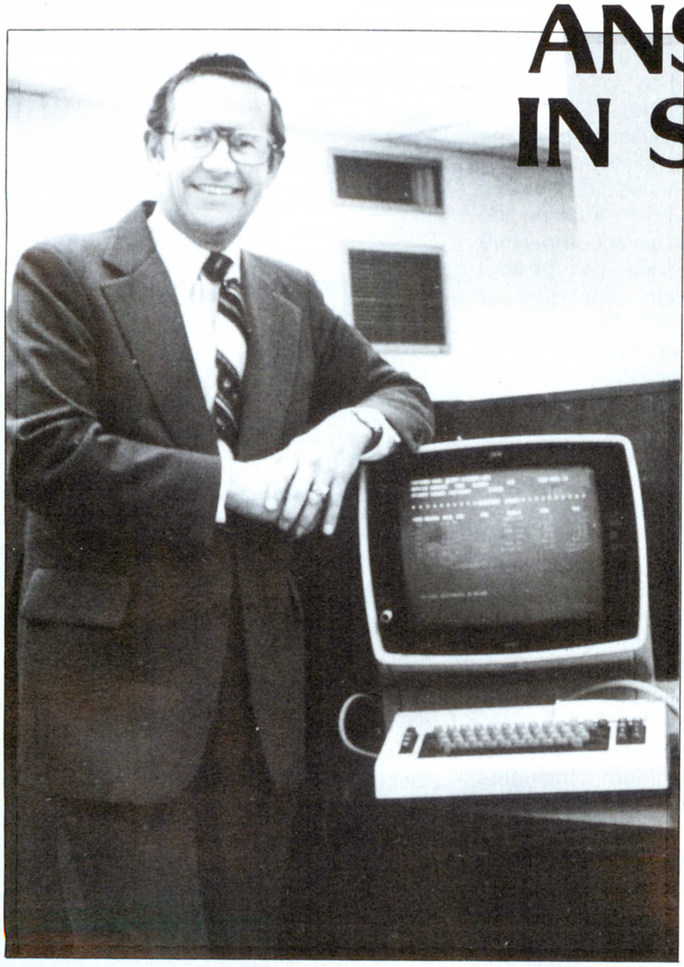

PHOTO 1 President and CEO Evern Wall wanted a tool that would provide a one-on-one relationship between his company and the customer.

Using online CRTs, customer service reps at El Paso Electric can answer customer inquiries on the spot. With the help of a computerized information system, it takes two seconds or less to retrieve customer account data on the tube.

The Arab oil embargo did more than just quadruple the cost of oil and natural gas in this country. It made utility customers start examining their bills very carefully. People who previously never gave a second thought to current meter readings, kilowatt hours used, and billing rates suddenly became very concerned with these details. Daily telephone calls to local power companies increased tenfold.

"Before the winter of 1973," says Evern Wall, president and chief executive officer of El Paso Electric Company, an investor-owned utility serving 170,000 customers in Texas and New Mexico, "our customer relations were calm. We had an average of 300 calls a day, with no particular complaints about the cost of electricity. But when the Arab oil embargo hit, the tremendous shortage of gas in the U.S. and the lack of refining facilities put tremendous pressure on all the utility companies. At EPE, we were forced to ask for the first rate increase in our 72-year history."

PHOTO 2 The only factor that limits the speed at which a customer can be served, says customer service manager Irene Wolfe, is how fast the service rep can talk.

The increase was granted and went into effect in January, 1975. Shortly after the next utility bills went out, customer calls jumped to 3,000 per day. The switchboard was inundated, customers were transferred from department to department and placed on hold, while service reps vied with each other for the ledgers they needed to answer questions about each account. It was a potentially disastrous situation, but EPE's response to it has developed into an online computer system that today allows the customer service staff to answer account questions in seconds.

The name of the system is CIS, the Customer Information System. A single database system, CIS contains total customer account information for the past 13-month period.

It uses IBM's DL/1 and CICS software packages to provide almost instant retrieval of this information at any of EPE's video display terminals. Customer service reps at 45 terminals communicate directly with EPE's central IBM 370/145 computer and pull answers about customer accounts in two seconds or less.

By keying in the proper transaction codes, the rep can display billing rates and amounts, billing history, credit information, merchandise information, money on deposit, area lamp data, or any adjustement information on the terminal screen. To explain a high bill amount, the rep may want to pull a one-year summary of the customer's account. The summary data reflects the customer's pattern of energy consumption and makes it easy to pinpoint seasonal fluctuations.

In addition to answering customer inquiries, the customer service rep can use the terminal to request a service order or meter check, update information on the account, or initiate adjustments. Instructions for cut-ins and cut-outs, name or rate changes, new service, setting or pulling a meter, adding or refunding a deposit, etc., can all be keyed into the terminal by the same service rep. As a result, a customer can take care of all his business with one telephone call.

"Speed is our greatest asset," says Bill Bostic, senior vice president. "Being able to respond quickly to our customer increases our productivity. That's money in the bank to us, and it keeps our customers happy."

According to Bostic, under EPE's old manual system, all customer calls went first to the central switchboard operator and were then distributed to the appropriate departments. The customer often had to consult with several different departments before questions or requests could be resolved. For new service, customers had to talk to the service department; for a complaint about a bill, they were transferred to the customer accounting department; to change information on an account, they talked to customer service; and so on.

In each department, the customer contact person would have to go and get one or more monthly ledgers, locate the appropriate account listing, look up the corresponding information on transaction cards, and call the customer back with the data. If the customer needed information from prior months — as was usually the case — the service rep would often have to go down to the basement to dig out the proper ledgers. When the rep called the customer back, the customer might have additional questions, and further research would be needed. The whole procedure could take four to five hours. "Call-backs doubled the time it took to handle the customer," explains Bostic. "Research quadrupled it."

In the meantime, the number of customers and inquiries was growing. "Even by increasing the work force and adding new phones," says Irene Wolfe, customer services manager, "it was physically impossible to handle the business by the method we were using. We were literally being buried by paper."

After handling the heavy, dusty ledgers, the customer service reps were in no frame of mind to speak courteously to utility customers. "The solution," says Bostic, "was to combine the information from all the customer contact areas and put it on a disk record that could be retrieved in total on the video terminal. When we accomplished this, we gave the service reps the tool they needed: complete information at their fingertips."

Today, a customer can place one phone call directly to EPE's customer service department. A rotary line system will automatically give the call to the first available service rep. The rep can update account information, request service action, and initiate adjustments for the customer right at the terminal.

Just before income tax time, when half the nation's utility customers discover that they've thrown their utility receipts away and rush to the phone to call their power companies, El Paso Electric no longer flinches. Almost at the punch of a button, an EPE service rep can give any customer a one-year summary of his account, including date, taxes paid, kilowatt hours used, and amount of billing.

The efficiencies of CIS are due to its central database concept. "To me," says Dean Jacobson, data processing manager, "the really big advantage is that there is no paperwork at all. We have eliminated keypunch errors and transcription problems altogether. The terminal operator, who is familiar with the information being entered on the tube, can visually verify the information on the screen while the customer is still on the phone. That information is immediately stored in a convenient location, so that if the customer needs to know what happened two to three weeks ago, or two to three months ago, the data is instantly accessible. There's no chance of losing it or having to look for hours to find the pertinent information."

Bostic adds, "This database system has tremendous advantages in other areas as well. Now that we have made the investment in equipment and software, we can bring in other applications — such as payroll, employee service records, inventory storage, and more — for minimal further cost. In that sense, CIS has just been the first step toward better management control and increased productivity for the company as a whole."☐

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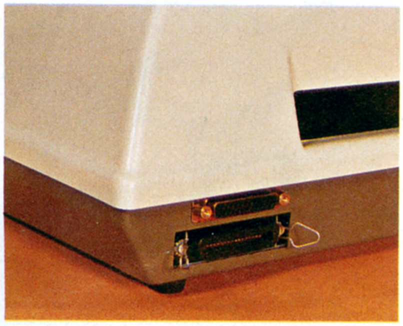

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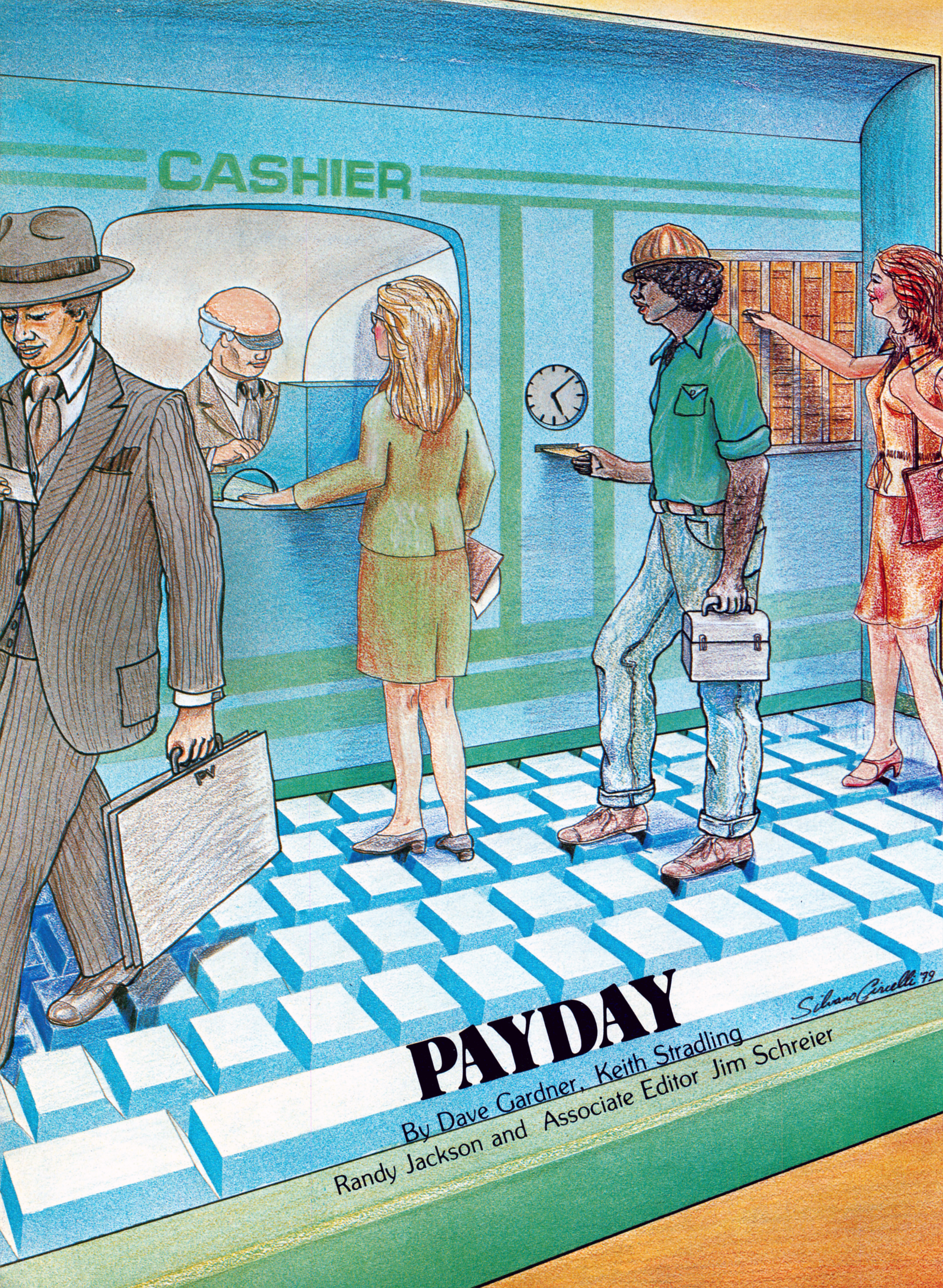
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PAYDAY

By Dave Gardner, Keith Stradling
Randy Jackson and Associate Editor Jim Schreier

Payday is what it is all about. In comparison the term "payday" even makes a hearty "heigh-ho, Silver" seem dull. This program is designed to transform payday into a "heyday" for the underappreciated payroll clerk and introduce microcomputer cost saving possibilities to the P&L bottom line.

Few bookkeeping chores are as involved as payroll. Besides the manual calculations, constant record keeping, personnel files, updating histories, check writing and a myriad of forms, plus the addition of local, state and federal taxes, payroll is a never-ending stomping ground for lots of concerned people. PAYDAY brings this merry-go-round of activity into a flexible format using MSI's 6800 extended disk BASIC v 1.2.

PREREQUISITES

PAYDAY is designed around the following microcomputer system:

1. An SWTPC or MSI 6800 computer
2. 32K RAM, including the BASIC
3. MSI extended disk BASIC v 1.2
4. Single MSI FD-8 disk drive
5. Lear-Siegler ADM-3A terminal
6. 132 column printer

A number of simple changes are possible. For example, PAYDAY can be adapted to MSI's v 1.3 BASIC. One may wish to alter the program so single-form instead of continuous-form paychecks are printed. Actually any terminal, with or without cursor addressing, may be used. Only one program, CHEM, assumes cursor control. Other changes may be more difficult. For example, to use an 80 column printer, all the TAB settings must be changed. Although adapting the listings to SWTPC's FLEX DOS and v 3.0 disk BASIC is possible, the authors do not have such listings.

PAYDAY OVERVIEW

PAYDAY is a full-functioning payroll system comprising 19 program modules. The listings published here provide flexibility, even though a number of unpublished program modules allow specialized applications for departmentalization, cost accounting, and even establishing a payroll service bureau. These additional applications are beyond the scope of this article. More information may be obtained from the authors.

PAYDAY handles 300 employees. Employee records may be added or deleted any time, and employee files are updated as necessary. Both employee lists and employee histories may be printed. This program calculates up to three pay periods for three types of pay situations. Federal tax files may be built. A number of deductions are allowed including the local and state taxes. Three main deductions as well as a single general deduction may be requested. Along with the payroll checks, PAYDAY responds with a number of reports. The payroll report consists of three registers and the necessary month-to-date, quarter-to-date and year-to-date reports.

MSI SYSTEM OVERVIEW

The MSI disk extended BASIC v 1.2 is one of the best business BASICs now available. One reason MSI BASIC is so valuable is because it supports *true* random access files. PAYDAY requires this random access ability because of massive files. Each employee is given two 128 byte sectors. The reason payroll files for 300 employees fit on a single 8-inch floppy disk is because of compact use of BASIC module programming.

The data files link together two files, PERFILE and EMPHST. PERFILE has the personnel information including name, address, rates of pay, deductions, etc. EMPHST maintains the current month-to-date, quarter-to-date and year-to-date information. In addition, PAYDAY uses three system files. MASTER and MASTE1 store, in part, the company's name and address, federal and state tax ID numbers, the bank and its address and the *current* date. The current date is important. A sophisticated built-in control matches certain dates. Faulty date input locks check-writing capabilities. This helps confuse potential program tampering. The last system file, PAYCTL, includes federal and state tax rates and the federal tax tables.

A few comments about the MSI BASIC. The SET command randomly accesses specific employee records on the hard sectored disk. In addition, each program module uses the CHAIN command. CHAIN, in effect, calls forth the next program where it is loaded automatically into RAM. PAYDAY is a system of progressively chained programs.

Some programmers may wonder about the way the data files are accessed. Note that each data file is accessed with a string. This is because the file initially may not contain a numeric variable, but MSI BASIC will easily handle string variables from a field statement. PAYDAY converts the string statement to a numeric variable through extensive MID$ and VAL functions. This technique may be of assistance to other MSI programmers. For additional background on the MSI system, see Mr. Billing's "Full Function Mailing List System," INTERFACE AGE, May, 1978; p 56ff.

INITIALIZATION

There are several starting procedures necessary to run PAYDAY. Each disk should be prepared with the MSI BASIC v 1.2 residing as the first file following the DOS. This allows booting BASIC with the PROM bootstrap program. Because MAIN is CHAINED in regularly, it should be placed on the disk next. Now commence the file creation.

Load and run TBLE to set up the federal tax tables. PAYDAY uses the weekly, bi-weekly and monthly tax tables. Please maintain this order in actual application. Altering the order affects other program modules. Load and run CH10, entering the proper data requested. Then load and run CH11 answering the questions. Follow this with loading the running CHCF, entering the proper tax rates and limits. The last item, "value of 1 allow table 1" requests the amount of 1 withholding allowance for the tax tables entered in the program TBLE. You may wish to refer to Circular E, Employer's Tax Guide, page 3, or contact your local IRS office.

The 2 data files, PERFILE and EMPHST, are entered and updated in normal day-to-day operation. The rest of the BASIC programs are entered from the master list.

PAYDAY DOCUMENTATION

PAYDAY is an interactive program requiring an operator's input. The first program module called is START. Today's date must now be entered into the program. This one key date, unless perfect, prevents the printing function. The next program CHAINED is MAIN. This documentation will follow the outline of programs presented in MENU.

```
DO YOU WISH TO:

1 ADD EMPLOYEES
2 EDIT EXISTING EMPLOYEE RECORDS
3 INITIATE PAYROLL RUN
4 CONTINUE PAYROLL RUN
5 PRINT A LISTING OF ALL EMPLOYEES
6 PRINT W-2 FORMS
7 CHANGE EMPLOYEES HISTORY
8 PRINT HISTORICAL REPORT
9 BUILD F.I.T. WITHHOLDING TABLES


SELECTION?
```

Figure 1.

1. Add Employees

The chief item in this module to be aware of is that the city, state and zip code must be entered without commas. The operator is prompted for the pay-code. The program expects a "W" for wages or hourly personnel, "S" for salary and

"C" for commission. The pay rate must be corrected to the pay-code unit. For example, entering $1,000 for a monthly salaried employee using pay-code "W," the paycheck would be printed at the rate of $1,000 per hour.

The state tax rate expects a per-cent figure. PAYDAY has been built around the Arizona state tax system which is normally 10% of the withheld federal tax. This rate may be varied as necessary. MAIN is CHAINED.

```
            PROGRESSIVE CHAINING SEQUENCE

   1    ADD EMPLOYEES
                                                   ADEM
                                                   MAIN

   2    EDIT EXISTING EMPLOYEE RECORDS
                                                   CHEM
                                                   MAIN

   3    INITIATE PAYROLL RUN
                                                   STRT
                                                   PINP
                                                   MAIN

   4    CONTINUE PAYROLL RUN
                                                   TAXS
                                                   UPDT
                                                   PCHK
                                                   PWR1
                                                   PWR2
                                                   PWR4
                                                   MAIN

   5    PRINT LISTING OF ALL EMPLOYEES
                                                   PREM
                                                   MAIN

   6    PRINT W-2 FORMS
                                                   PW-2
                                                   MAIN

   7    CHANGE EMPLOYEE HISTORY
                                                   CHHS
                                                   MAIN

   8    PRINT HISTORICAL REPORT
                                                   HSTY
                                                   MAIN

   9    BUILD FIT W/H TABLES
                                                   TBLE
                                                   MAIN
```

Figure 2.

2. Edit Existing Employee Records

This module allows modification of the information recorded in ADEM. CHEM requests the current work status of the employee with "A" meaning active and "T" meaning terminated. Next, a request is made for the deduction calculation code. Five codes are used: 0, 1, 2, S and E. Code "0" is for weekly tax tables, "1" for bi-weekly, "2" for monthly, "S" is special and "E" is a deducted amount.

"S" means that a given percentage figure of the gross will be deducted. If no % sign exists in the field, the dollar amount is calculated and deducted. "E" requests that the deduction amount be entered directly.

Note that lines 291-292 are not used for direct check calculation at this time. The data needed is provided from the PINP program module. Lines 295-296, however, are important if bonus and/or expense reimbursement are to be utilized in the payroll calculation. The figures must be entered at this point. Once entered, the figures remain in effect until zeroed out.

3. Initiate Payroll Run

This sequence is actually a number of progressively CHAINED modules. The first module to be CHAINED is STRT.

STRT assumes 1 check is wasted by the traction printer. The program requests this check number. Next the current period ending date is requested and entered. This date is important because this date is actually imprinted on the payroll checks. All dates entered previously are compared to this date. If this date fails to match the previous ones, no checks will be printed. This safeguard helps prevent more than one check being printed per employee for the same time period. The next prompt for hourly, salary or commission employees allows various payroll periods for each class to be paid. The PINT module is CHAINED.

More information is requested for the hourly, salaried and commission employees. Based on the response, the program prompts for the amount of hours an hourly employee has worked per pay period. Care must be used to maintain the pay-rate for a given pay period. If the pay period is weekly, the pay-rate is 40 hours. If the pay-period is bi-weekly, the pay-rate is 80 hours, etc.

These pay period hours may be entered one of two ways. If the total hours for the pay period are already calculated, enter "T" for total hours. But to calculate the hours from a 24-hour time card, enter "C". This allows a brief subroutine to figure the punched times, calculate the total hours per time card and continue with the program. This time card calculation feature could save enough man-hours each year to probably pay for the hardware.

If a salaried employee response is used, nothing need be entered. The proper information is carried within the files. The commission request asks that the actual dollar amount of the commission be entered. MAIN is now CHAINED.

4. Continue Payroll Run

This section requires a minimum amount of input. TAXS is CHAINED. At this point the proper taxes are figured from the tax tables. CHAIN UPDT. Here the operator is requested to erase year-to-date, quarter-to-date and month-to-date information. If the operator answers "yes" to year-to-date, everything is deleted. Likewise, quarter-to-date deletes month-to-date. Next PCHK is CHAINED. Here's the proof of the pudding. This program prints the paychecks. It should be noted that other checks such as credit union checks, union dues, may be printed at this time. These programs are beyond the scope of this article even though the programs contain the necessary features for implementation.

Three report/print programs are called. The first report, PWR1, prints the payroll register with the employee wage breakdown. PWR2's register shows the deductions and net pay. PWR4 reports the paychecks printed with the check number. It should be noted that all columns are totaled at the end of each respective report. Next MAIN is CHAINED.

5. Print A Listing of All Employees

This section is self-explanatory.

6. Print W-2 Forms

This module is a little unique as it attempts to save printing expense by formatting your own W-2 forms. When PAYDAY was written, the W-2 format was correct. New IRS alterations may now be in effect. Refer to the IRS Employer's Tax Guide, page 5, item #F for additional information, or contact local IRS offices for current policy.

7. Change Employee's History

This program should seldom be used. This, in fact, is the most sensitive program in the listing. You may wish to remove it to a separate disk or protect it with a password. This would help protect the data from unauthorized tampering.

8. Print Historical Report

Three reports may be called. These are employee totals for the month-to-date, quarter-to-date and year-to-date. This program will fill out the 941 federal quarterly report. PAYDAY, however, allows formatting the 941 to specific, state by state needs.

9. Build F.I.T. Withholding Tables

The last PAYDAY module builds three sets of federal withholding tables. It is important that these tables maintain correlation in the order they will be accessed by other programs. Reference to the Employer's Tax Guide, pages 4-5, will assist in building these withholding tables.

Memory Usage

NOTE: All references to number of bytes used by a program are calculated before the variables are assigned and therefore are on the low side. Some programs may have as much as 4,000 bytes added with the variables. All references include the size of MSI BASIC.

Program	No. Bytes
TBLE	18,734
MAIN	15,879
INIT	15,655
ADEM	17,103
CHEM	17,823
CHHS	17,220
CHCF	16,373
PINP	16,825
START	15,470
TAXS	17,307
PREM	17,502
PWR1	17,347
PWR2	17,509
PWR4	17,699
PW-2	18,269
CH10	16,660
CH11	16,820
STRT	15,994
UPDT	18,941
PCHK	19,406
HSTY	17,538

Figure 3.

PROGRAM OPERATION MANUAL

Each module of the PAYDAY program is operated in the interactive mode. Each day these modules are used, start up by CHAINING START. This command will load and run a program which will set up the date parameters and then will CHAIN the MAIN program which prints out the MENU for further operations.

The following instructions follow the MENU numbering system.

1. ADD EMPLOYEES. This program allows up to 300 employees.
2. EDIT EXISTING EMPLOYEE RECORDS. This program allows changing data on an existing employee. One thing to remember is that if an item number called up for a change is found to be correct, it must be re-entered so it will be returned to the disk.

```
$BASIC                          PWR3
MAIN                            PW-2
MASTER       Data File          HSTY
MASTE1       Data File          INIT
PERFIL       Data File          TBLE
EMPHST       Data File          CHHS
PAYTAB       Data File          CHCF
PAYCTL       Data File          CH10
PCHK                            CH11
ADEM
CHEM
PINP
START
STRT
TAXS
UPDT
PREM
PWR1
PWR2
```

Figure 4.

3. INITIATE PAYROLL RUN. Before this command is executed, all employees' files must be up-to-date. Be sure that the rate of pay, the pay code, deduction amounts, etc. are all correct for this payroll period. This command brings up a series of programs that prepare the disk files for the printing sequence. The programs are interactive and will require operator input. The important item to remember is that the starting date and the current payroll date must be the same.
4. CONTINUE PAYROLL RUN. This series of programs figures the taxes and updates the cumulative records, then it prints the paychecks and several other payroll reports.
5. PRINT A LISTING OF ALL EMPLOYEES. This module prints out a complete list of all employees in the payroll file.
6. PRINT W-2 FORMS. This program generate a full set of W-2 forms for all employees. It requires only single ply continuous form paper.
7. CHANGE EMPLOYEE'S HISTORY. This allows changing or adding to an employee's file.
8. PRINT HISTORICAL REPORT. This program prints month-to-date, quarter-to-date and year-to-date reports on all employees. These reports are used to complete form 941 and various state forms.
9. BUILD F.I.T. WITHHOLDING TABLES. This program builds through the entry, from Circular E of the federal tax forms, three of the pay periods of the F.I.T. withholding tables.☐

PROGRAM 1

```
0010 REM TBLF.BAS WRITTEN FEB '78 BY DAVE GARDNER
0020 REM PAYROLL INCOME TAX W/H  TABLE CREATION PROGRAM
0025 STRING= 128:LINE=0
0027  O$="                                        "
0030  H$=LEFT$("OVER"+O$,18)+LEFT$("BUT NOT OVER"+O$,40)+"OF EXCESS OVER"
0040  L$=LEFT$("$115"+O$,17)+LEFT$("-$183      $16.32 PLUS 23%"+O$,40)
0041  L$=L$+"-$115"
0050 DIM D$(5),T(15,5),P$(4)
0055  P$(0)="SINGLE PERSON"
0057  P$(1)="MARRIED PERSON"
0060 OPEN #11, MASTE1 FOR INPUT
0062 FIELD #11, A$=119,B$=96,C$=40
0064 GET #11:D$(0)=LEFT$(C$,13):D$(2)=MID$(C$,14,13):D$(4)=MID$(C$,27,13)
0066 FOR X=0TO2:D$(X*2+1)=D$(X*2):NEXT X:CLOSE#11
0070 FOR X=0 TO 5:D$(X)=D$(X)+" PAYROLL PERIOD - "+P$((X/2-INT(X/2))*2)
0080 NEXT X
0090 OPEN #14, O PAYTAB FOR UPDATE
0095 FIELD #14, A$=10
0100  P$(1)=LEFT$(" ^"+O$,29)+LEFT$("^"+O$,10)+"^"
0110  P$(2)=LEFT$(" *"+O$,29)+LEFT$("*"+O$,10)+"*"
0120  P$(3)= P$(2): P$(4)= P$(2)
0130 ? CHR$(26)
0150 ? "WE ARE NOW GOING TO BUILD THE PAYROLL FIT W/HOLDING TABLES."
0160 ? "YOU WILL NEED A CURRENT 'CIRCULAR E'."
0170 ? "IT IS PRINTED AND DISTRIBUTED BY THE I.R.S.":PRINT
0180 ? "DO YOU HAVE IT";:INPUTA$:IF A$<>"YES" THEN ?"GET IT!!!": GOTO 180
0190 ? CHR$(26)
0200 ? " NOW FIND THE TABLES FOR PERCENTAGE METHOD OF WITHHOLDING."
0210 ? "DO YOU HAVE THEM";: INPUT A$
0220 IF LEFT$(A$,1)<>"Y" ?"KEEP LOOKING!!!": GOTO 210
0230 ? CHR$(26)
0240 ? " I WILL HOLD YOUR HAND AND HELP YOU ALL I CAN,"
0250 ? "BUT IF YOU GIVE ME WRONG DATA AND DON'T CORRECT IT,"
0260 ? " THE SYSTEM WILL NOT CALCULATE FEDERAL AND STATE INCOME TAX"
0270 ? "WITHHOLDING CORRECTLY!"
0280 ? "DO YOU UNDERSTAND";: INPUT A$
0290 IF LEFT$(A$,1)<>"Y" GOTO 230
0300 ? CHR$(26)
0310 ? "I AM ONLY INTERESTED IN 3 NUMBERS FROM EACH LINE IN EACH TABLE."
0320 ?
0330 ? " I ONLY NEED DATA FROM THE FOLLOWING TABLES:":?
0340 FOR I=0 TO 5:?D$(I):NEXT I
0350 ? " A LINE OF DATA FROM A TABLE SHOULD LOOK SIMILAR"
0360 ? "TO THE FOLLOWING:":?:?H$:?L$
0370 ? :?:?:?"DOES IT";:INPUT A$:IF LEFT$(A$,1)="Y" THEN 420
0380 ? "IF YOU ARE RIGHT, THE SYSTEM MAY REQUIRE MODIFICATION"
0390 ? "BY A PROGRAMMER.":?
0400 ? "ARE YOU SURE IT DOESN'T LOOK LIKE THAT";:INPUT A$
0410 IF A$<>"YES" THEN 350
0415 ? "CALL PROGRAMMER !!!";CHR$(7):GOTO 750
0420 ? CHR$(26)
0425 ? H$:?L$
0430 FOR I=1 TO 4:?P$(I):NEXT I
0440 ? "CAN YOU GUESS WHICH 3 NUMBERS I NEED FOR EACH LINE";
0450 INPUT A$:IF A$="YES" GOTO 470
0460 ? "PULL YOUR HEAD OUT AND OPEN YOUR EYES!!!!!"+CHR$(7):GOTO 425
0470 FOR I=1 TO 6
0480 ? "WE WILL NOW BUILD THE FOLLOWING TABLE:":?:?D$(I-1)
0490 ? :?"HOW MANY LINES OF DATA ARE IN THIS TABLE";
0500 INPUT A:IF A=INT(A) THEN IF A>0 THEN IF A<16 THEN 520
0510 ? "YOU EXCEEDED THE MAXIMUM # OF LINES, OR TYPED SOMETHING WRONG--";
0515 ? "TRY AGAIN":GOTO 490
0520 ? "TYPE THE 3 NUMBERS FOR EACH LINE,LEFT TO RIGHT, ";
0525 ? " WHEN ASKED FOR THE APPROPRIATE NUMBER (1,2, OR 3)":?:?
```

```
0280 INPUT "STATE W/H RATE IN %",A
0285  D$=LEFT$(STR$(A)+O$,7):B$=B$+"0000000"+D$
0290  B$=B$+"0000000"+X$+"0000000"
0300  C$="0000000000000000000000"
0310 INPUT "NUMBER OF EXEMPTIONS",A:C$=C$+LEFT$(STR$(A)+O$,2)
0320 INPUT "OCCUPATIONAL RISK CATEGORY",A
0325  C$=C$+LEFT$(STR$(A)+" ",1)
0330  C$=C$+"000000000000000000000000000"
0340  D$="0000000000000000000000000000000000000000000000000000000"
0350  D$=D$+D$+"00000":E$=D$:F$=D$
0360 REWRITE #12:REWRITE #13:GOTO 130
0370 SET #11=1:GET #11:D$=MID$(A$,54)
0375  E$=MID$(A$,45,6)
0384  Q$=LEFT$(STR$(C5)+O$,6)+E$:D$=LEFT$(STR$(N1)+O$,3)+D$
0385  A$=LEFT$(A$,38)+Q$+D$
0388 REWRITE #11
0390 CLOSE #11,#12,#13
0400 CHAIN MAIN
```

PROGRAM 3

```
0010 REM CHCF.BAS WRITTEN 3/15/78 BY DAVE GARDNER
0020 STRING= 128:LINE=80:?CHR$(26):DIM D$(12)
0022  O$="
0023  O$=O$+O$
0030 DATA "001007FUTA TAX RATE"
0040 DATA "008014SUTA TAX RATE"
0050 DATA "015023FUTA TAX LIMIT"
0060 DATA "024032SUTA TAX LIMIT"
0070 DATA "033039FICA TAX RATE"
0080 DATA "040048FICA TAX LIMIT"
0090 DATA "049055VALUE OF 1 ALLOW TABLE 1"
0100 DATA "056062VALUE OF 1 ALLOW TABLE 2"
0110 DATA "063069VALUE OF 1 ALLOW TABLE 3"
0150 DATA ""
0160  C=0:OPEN#15, PAYCTL FOR UPDATE
0170 READ D$:IF D$<>"" D$(C)=D$:C=C+1:GOTO 170
0175  A$=O$
0180 FIELD #15, A$=100
0185 GET #15
0190 ? "DO YOU WISH TO:":?:?1;TAB(5);"EXIT"
0200 ? 2;TAB(5);"CHANGE CONTROL FILE":?3;TAB(5);
0210 ? "ENTER NEW CONTROL FILE":?:INPUT "CHOICE",C1
0220 IF C1>0 IF C1<4 IF C1=INT(C1) THEN 240
0230 GOTO 190
0240 ON C1 GOTO 350,280,250
0250  A$=O$
0255 FOR X=1 TO C
0260 GOSUB 9000
0270 NEXT X
0275 ? CHR$(26);:GOTO 190
0280 ? CHR$(26);"DO YOU WISH TO CHANGE":?
0290 FOR X=1 TO C
0300 ? X;TAB(5);MID$(D$(X-1),7):NEXT X:?
0310 INPUT "SELECTION (0 TO EXIT)",X
0320 IF X=0 ?CHR$(26):GOTO 190
0330 IF X>0 IF X<C+2 IF X=INT(X) GOSUB 9000
0340 GOTO 280
0350 REWRITE #15:CLOSE #15:CHAIN MAIN
9000  X1=VAL(LEFT$(D$(X-1),3)):X2=VAL(MID$(D$(X-1),4,3))
9010  D$=MID$(D$(X-1),7):B$=LEFT$(A$,X1-1):C$=MID$(A$,X2+1)
9020 IF C1=3 THEN 9040
9030 ? "THE ";D$;" WAS ";MID$(A$,X1,X2-X1+1)
9040 ? "THE ";D$;" WILL NOW BE ";:INPUT A1
9050  A$=LEFT$(STR$(A1)+O$,X2-X1+1)
9060  A$=B$+A$+C$:RETURN
```

```
0530 ? :FOR J=1 TO A:?:?"LINE ";J:?
0540 INPUT "  1. ",T(J,1):INPUT "  2. ",T(J,3):INPUT "  3. ",T(J,4):NEXTJ
0550 FOR J=1 TO A:T(J,2)=T(J+1,1):T(J,5)=T(J,1):NEXT J
0560  T(A,2)=1.00000E+06:?:?
0570 ? "NOW CHECK THE NUMBERS!!"
0580 FOR J=1 TO A:PRINT T(J,1),T(J,2),T(J,3),T(J,4),T(J,5):?:NEXT J
0590 ? :?"IS ALL THE DATA CORRECT";
0595 INPUT A$
0600 IF A$="YES" THEN 670
0605 ? "DO YOU WISH TO:":?:?"1-START OVER  2-RETYPE A LINE":?
0610 INPUT "SELECTION",C:IF C=INT(C) IF C>0 IF C<3 ON C GOTO 480,630
0620 GOTO 570
0630 ? "LINE # TO CHANGE";:INPUT C:IF C=INT(C)  IF C>0 IF C<=A THEN 650
0640 ? "INVALID--TRY AGAIN":GOTO 630
0650 ? "GIVE ME THE 3 NUMBERS FOR THAT LAST LINE AGAIN."
0660 INPUT "  1. ",T(C,1):INPUT"  2. ",T(C,3):INPUT"  3. ",T(C,4):GOTO550
0670 SET #14=1: GET #14:A$=STR$(A): REWRITE #14
0680 SET #14=I*45-38:FORJ=1 TO A
0690 GET #14: A$=STR$(T(J,1)): REWRITE #14: GET #14
0695  A$= STR$(T(J,3)): REWRITE #14:GET#14
0700  A$=STR$(T(J,4)/100):REWRITE #14
0710 NEXT J:?:?
0720 NEXT 1
0730 ? "TABLE CREATION COMPLETED."
0740 CLOSE #14:CHAIN MAIN
0750 END
```

PROGRAM 2

```
0010 REM ADEM.BAS WRITTEN 3/14/78 BY DAVE GARDNER
0020 STRING= 128:?CHR$(26):DIM D$(2)
0022 OPEN #10, MASTER FOR INPUT
0025 FIELD #10, A$=100,B$=100,C$=55
0028 GET #10:CLOSE #10:X$=RIGHT$(C$,8)
0030 OPEN #11, MASTE1 FOR UPDATE
0040 FIELD #11, A$=100,B$=100,C$=55
0050 GET #11: N1=VAL("0"+MID$(A$,51,3))
0055  C5=N1
0060 OPEN #12, PERFIL FOR UPDATE
0070 FIELD #12, A$=103,B$=103,C$=49
0075  O$="                                 "
0080 OPEN #13, EMPHST FOR UPDATE
0090 FIELD #13, D$=100, E$=103, F$=52
0100  D$(0)=MID$(A$,88):D$(1)=MID$(B$,20,32):D$(2)=MID$(B$,52,32)
0110  D$=LEFT$(B$,19):D$(0)=D$(0)+D$
0115 FOR X=0 TO 2:FOR Y=LEN(D$(X)) TO 1 STEP-1
0120 IF MID$(D$(X),Y)=" " NEXT Y
0125  D$(X)=LEFT$(D$(X),Y):NEXT X
0130 SET #13=N1+1:GET#13:SET#12=N1+1:GET#12:?CHR$(26)
0140 ? "EMPLOYEE # ";C5+1:A=C5+1:INPUT "CONTINUE ( Y OR N)",A$
0150 IF ASC(A$)=78 THEN 370
0155  C5=C5+1
0160  N1=N1+1:A$=LEFT$(STR$(A)+O$,5):INPUT"EMPLOYEE NAME",B$
0170  B$=LEFT$(B$+O$,32):A$=A$+B$:INPUT "ADDRESS",B$
0175  B$=LEFT$(B$+O$,30):A$=A$+B$
0180 INPUT "CITY, STATE, & ZIP",B$:B$=LEFT$(B$+O$,30):A$=A$+B$
0190 INPUT "DEPARTMENT #",A:A$=A$+STR$(A)
0200 INPUT "MARITAL STATUS (M OR S)",B$:B$=LEFT$(B$+" ",1)
0210 INPUT "SOCIAL SECURITY",C$:B$=B$+LEFT$(C$+O$,11)
0220 INPUT "PAY CODE (W,S, OR C)",C$:B$=B$+LEFT$(C$+O$,1)+"A"+X$
0230 INPUT "DATE OF BIRTH (MM/DD/YY)",C$:B$=B$+"00/00/00"+LEFT$(C$+O$,8)
0240 INPUT "PAY RATE",A:B$=B$+"0"+LEFT$(STR$(A)+O$,7)
0250 FOR X=0 TO 2:A=0: IF D$(X)="" THEN 270
0260 ? D$(X);" AMOUNT";:INPUT A
0270  B$=B$+LEFT$(STR$(A)+"       ",7):NEXT X
```

PROGRAM 4

```
0010 REM TAXS.BAS WRITTEN 3/16/78 BY DAVE GARDNER
0015 REM ADAPTED BY RANDY JACKSON--PERSONAL COMPUTER PLACE
0020 STRING= 128:LINE=80:?CHR$(26);"PLEASE BE PATIENT"
0022 OPEN #10, MASTER FOR INPUT
0024 FIELD #10,A$=100,B$=100,C$=55
0028 GET #10:CLOSE #10:X$=RIGHT$(C$,8)
0030 OPEN #11, MASTE1 FOR INPUT
0040 FIELD #11, A$=119, B$=93, C$=43
0050 GET #11:CLOSE#11:N1=VAL("0"+MID$(A$,51,3))
0060 OPEN #14, PAYTAB FOR INPUT
0070 FIELD #14, A$=10
0080 DIM Q(5),T(89,2),A(3)
0090 FOR X=1TO 6:GET #14:Q(X-1)=VAL("0"+A$):NEXTX
0100 FOR X=0 TO 5:FOR Y=0 TO 14:FOR Y1=0 TO 2
0110 GET #14:T((X*15)+Y,Y1)=VAL("0"+A$)
0120 NEXT Y1:NEXT Y:NEXT X
0125 DEF FNR(X)=INT(X*100+.5)/100
0130 OPEN #15, PAYCTL FOR INPUT
0140 FIELD #15, A$=100
0150 GET #15:CLOSE#15:A(0)=VAL("0"+MID$(A$,49,7))
0160  A(1)=VAL("0"+MID$(A$,56,7)):A(2)=VAL("0"+MID$(A$,63,7))
0165  A(3)=VAL("0"+MID$(A$,33,7))/100
0170 OPEN #12, PERFIL FOR INPUT
0180 FIELD #12, A$=103, B$=103, C$=49
0190 OPEN #13, EMPHST FOR UPDATE
0200 FIELD #13, D$=100,E$=104,F$=51
0210 FOR X= 1 TO N1:GET#12
0220 IF MID$(B$,23,8)<>X$ THEN 540
0225 GET #13
0227 IF MID$(B$,14,1)="T" THEN 600
0230 IF MID$(B$,13,1)="W" THEN 270
0240 IF MID$(B$,13,1)="S" THEN 300
0250 IF MID$(B$,13,1)="C" THEN 300
0255 ? "ILLEGAL PAY CODE ON # ";LEFT$(A$,5);" HOURLY ASSUMED";CHR$(7)
0270  R=VAL("0"+MID$(B$,97)):X1=VAL("0"+MID$(B$,40,7))
0280  R1=VAL("0"+LEFT$(C$,7)):R=X1*R:R1=X1*R1*1.5
0290 GOTO 310
0300  R1=0:R=VAL("0"+MID$(B$,40,7))
0310  T=VAL("0"+MID$(B$,39,1))
0320  T=T*30
0330  B1=VAL("0"+MID$(C$,8,7))
0340  P=R+R1+B1
0350  F2=P*A(3):F1=0:P1=P
0360 IF MID$(B$,39,1)="E" THEN 490
0370 IF MID$(B$,39,1)="S" THEN 470
0380  P1=P-VAL("0"+MID$(C$,22,2))*A(INT(T/30))
0390 IF LEFT$(B$,1)="M" T=T+15
0410 FOR X1=1 TO Q(INT((T+1)/15))
0420 IF P1<=T(T+X1-1,0) X1=X1-1: GOTO 440
0430 NEXT X1
0440 IF X1=0 THEN 490
0450  F1=T(T+X1-1,1):X2=P1-T(T+X1-1,0):IF X2<0 X2=0
0460  F1=F1+X2*T(T+X1-1,2):GOTO 490
0470 IF MID$(B$,82,1)<>"5" F1=VAL("0"+MID$(B$,82,7)):GOTO 490
0480  X1=VAL("0"+MID$(B$,83,6))/100:F1=P1*X1
0490  S1=F1*.1
0500  G$=MID$(D$,66):Q$="       "
0505  D$=LEFT$(STR$(FNR(R))+Q$,7)+LEFT$(STR$(FNR(R1))+Q$,7)
0510  D$=D$+LEFT$(STR$(FNR(F1))+Q$,7)+LEFT$(STR$(FNR(S1))+Q$,7)
0515  D$=D$+LEFT$(STR$(FNR(F2))+Q$,7)
0520  D$=D$+"00000000000000000000000000000000"
0530  D$=D$+G$
0535 REWRITE #13
0540 NEXT X
0550 CLOSE #12,#13
```

```
0560 CHAIN UPDT
0600  G$=RIGHT$(D$,65)
0610  D$="0000000000000000000000000000000000999999"
0620  D$=D$+G$
0630 GOTO 535
```

PROGRAM 5

```
0010 REM PWR2 BAS WRITTEN 3/22/78 BY DAVE GARDNER
0011 REM ADAPTED BY RANDY JACKSON--PERSONAL COMPUTER PLACE
0020 STRING= 128 LINE=0 ?CHR$(26) Z=0 P=0 L1=66
0022  O$="                    "
0025  Z=4
0030 OPEN #10, MASTER FOR INPUT
0040 FIELD #10, A$=92, B$=104, C$=59
0050 GET #10 CLOSE #10 DIM H$(6),T(6)
0055  X$=RIGHT$(C$,8)
0060  H$(0)=MID$(A$,7,46) H$(1)=MID$(A$,53,40) H$(2)=LEFT$(B$,40)
0065  H$(3)=MID$(B$,41,32) H$(4)=MID$(B$,73)
0070 FOR X=0T04 FORY=LEN(H$(X))TO1STEP-1 IF MID$(H$(X),Y,1)=" " NEXT Y
0080  H$(X)=LEFT$(H$(Y),Y) NEXT X
0090 OPEN #11, MASTE1 FOR INPUT
0100 FIELD #11, A$=119, B$=96, C$=40
0110 GET #11 CLOSE #11 H$(5)=X$ H$(6)=MID$(B$,66,8)
0115 IF MID$(B$,14,1)="T" THEN 350
0120  N1=VAL("0"+MID$(A$,51,3)) Y1=VAL("0"+MID$(A$,45,6))
0130 OPEN #12, PERFIL FOR INPUT
0140 FIELD #12, A$=103, B$=103, C$=49
0150 OPEN #13, EMPHST FOR INPUT
0160 FIELD #13, D$=100, E$=104, F$=51
0170 GOSUB 9000
0180 FOR X=1 TO N1 GET#12 IF MID$(B$,23,8)<>X$ THEN 350
0190 GET #13 FOR Y=5 TO 1 STEP-1 IF MID$(A$,Y,1)=" " NEXT Y
0195  G$=LEFT$(A$,Y)
0200 ? #Z,RIGHT$(O$+G$,6);"  ";MID$(A$,6,32);
0210  A=VAL("0"+MID$(C$,8,7))+VAL("0"+LEFT$(D$,7))
0220  A=A+VAL("0"+MID$(D$,8,7)) T(0)=T(0)+A
0225 DIGITS= 2
0230 ? #Z,RIGHT$(O$+STR$(A),11); A1=VAL("0"+MID$(D$,15,7))
0240  T(1)=T(1)+A1 A=A-A1
0245 ? #Z,RIGHT$(O$+STR$(A1),9);
0250  A1=VAL("0"+MID$(D$,22,7))
0255 ? #Z,RIGHT$(O$+STR$(A1),9);
0260  T(2)=T(2)+A1 A=A-A1 A1=VAL("0"+MID$(D$,29,7))
0270  A=A-A1 T(3)=T(3)+A1 ?#Z,RIGHT$(O$+STR$(A1),9);
0275  A=A+VAL("0"+MID$(C$,15,7))
0280  T(4)=T(4)+1 ?#Z,RIGHT$(O$+STR$(A),15);
0290  A1=VAL("0"+MID$(C$,32,7))
0300 FOR A2=0 TO 3
0310  A1=A1+VAL("0"+MID$(B$,A2*7+47,7)) NEXT A2
0320  T(5)=T(5)+A1 ?#Z,RIGHT$(O$+STR$(A1),11); A=A-A1
0330  T(6)=T(6)+1 ?#Z,RIGHT$(O$+STR$(A),11)
0335 DIGITS= 0
0340  L=L+2 IF L>59 GOSUB 9000
0350 NEXT X
0360 FOR X=L TO 59 ?#Z NEXT X
0370 ? #Z, "  TOTALS  ";
0380 DIGITS= 2 FOR X=0TO3 ?#Z,TAB(X*9+43);RIGHT$(O$+STR$(T(X)),9);
0382 NEXT X FOR X=4TO6 ?#Z,TAB(X*11+41);RIGHT$(O$+STR$(T(X)),9);
0385 NEXT X DIGITS=0 ?#Z
0390 CLOSE #12,#13 CHAIN PWR4
9000 ? #Z,CHR$(12) P=P+1 ?#Z,TAB(11);"PAGE ";P
9010 ? #Z,TAB(L1-LEN(H$(0))/2);H$(0)
9020 ? #Z,"FEDERAL EMPLOYER # :   ";H$(3);TAB(L1-LEN(H$(1))/2);H$(1);
9030 ? #Z,TAB(87);"CHECKS ARE DATED ";H$(5)
9040 ? #Z,"STATE EMPLOYER # :   ";H$(4);TAB(L1-LEN(H$(2))/2);H$(2)
9050 ? #Z,TAB(58);"PAYROLL REGISTER";TAB(87);"YTD PAYROLL # :  ";
```

```
0410 ? #Z," NAME";TAB(37);"*";TAB(51);"*";TAB(65);"*";TAB(78);"*"
0420 ? #Z,TAB(5);"*";TAB(16);"AND ADDRESS";TAB(37);"*";
0430 ? #Z,TAB(51);"*";TAB(65);"*";TAB(78);"*"
0440 ? #Z,"  > *";E$(1);LEFT$(S$,42) ?#Z,TAB(5);"*";E$(2);"*  ";
0450 ? #Z,"STATE TAX  * STATE WAGES *   STATE    *"
0460 ? #Z,TAB(5);"*";E$(3);"*"; L=13 A1=A(4) GOSUB 8000
0470 ? #Z,"*"; A1=A(3) GOSUB 8000
0480 ? #Z,"*  ARIZONA   *"
0490 ? #Z,TAB(5);"*";TAB(37);LEFT$(S$,42) ?#Z,TAB(5);"*";TAB(37);
0500 ? #Z,"*  STATE TAX  * STATE WAGES *   STATE    *"
0510 ? #Z,TAB(5);"*";TAB(37);"*";TAB(51);"*";TAB(65);"*";TAB(78);"*"
0520 ? #Z,"      ";LEFT$(S$,74) ?#Z,"  FORM W-2" NEXT X1 NEXTX
0530 CLOSE #12,#13
0540 CHAIN MAIN
8000 DIGITS= 2 ?$Z,RIGHT$(O$+STR$(A1),L);
8010 DIGITS= 0 RETURN
8020 RETURN
```

PROGRAM 7

```
0010 REM UPDT BAS WRITTEN 3/16/78 BY DAVE GARDNER
0011 REM ADAPTED BY RANDY JACKSON--PERSONAL COMPUTER PLACE
0020 STRING= 128 LINE=80 ?CHR$(26);
0022  O$="             "
0025 DIM N(20)
0026 OPEN #10, MASTER FOR INPUT
0027 FIELD #10, A$=100,B$=100,C$=55
0028 GET #10 CLOSE #10 X$=RIGHT$(C$,8)
0030 INPUT "SHOULD I ERASE OLD YTD INFO ",A$
0040 IF ASC(A$)=89 N(2)=1 N(1)=1 N(0)=1 GOTO 100
0050 INPUT "SHOULD I ERASE OLD QTD INFO ", A$
0060 IF ASC(A$)=89 N(2)=0 N(1)=1 N(0)=1 GOTO 100
0070 INPUT "SHOULD I ERASE OLD MTD INFO ",A$
0080 IF ASC(A$)=89 N(2)=0 N(1)=0 N(0)=1 GOTO 100
0090  N(2)=0  N(1)=0  N(0)=0
0100 OPEN #11, MASTE1 FOR INPUT
0110 FIELD #11, A$=100, B$=100, C$=55
0120 GET #11 CLOSE#11 N1=VAL("0"+MID$(A$,51,3))
0130 OPEN #15, PAYCTL FOR INPUT
0140 FIELD #15, A$=100
0150 GET #15 CLOSE#15 N(4)=VAL("0"+MID$(A$,8,7))/100
0160  N(3)=VAL("0"+MID$(A$,7))/100
0170 OPEN #12, PERFIL FOR UPDATE
0180 FIELD #12, A$=103, B$=103, C$=49
0190 OPEN #13, EMPHST FOR UPDATE
0200 FIELD #13, D$=100, E$=104, F$=51
0210  N(5)=0 N(6)=0  N(7)=0
0220 FOR X=1 TO N1
0230 GET #12 GET#13
0240 IF MID$(B$,23,8)=X$ THEN 260
0242 IF MID$(B$,14,1)="T" THEN 795
0250 FOR X1=8 TO 16 N(X1)=0 NEXT X1  GOTO 370
0260  N(10)=VAL("0"+LEFT$(D$,7)) N(11)=VAL("0"+MID$(D$,8,7))
0270  N(12)=VAL("0"+MID$(D$,15,7)) N(13)=VAL("0"+MID$(D$,22,7))
0280  N(14)=VAL("0"+MID$(D$,29,7)) N(15)=VAL("0"+MID$(C$,8,7))
0290  N(16)=VAL("0"+MID$(C$,15,7)) N(17)=VAL("0"+MID$(C$,25,7))
0300  N(18)=VAL("0"+MID$(C$,32,7)) IF N(17)=0 N(8)=0 GOTO 320
0310  N(8)=(N(10)+N(11)+N(15))*N(3) IF N(17)=0 N(8)=0 GOTO 320
0320 IF N(18)=0 N(9)=0 GOTO 340
0330  N(9)=(N(10)+N(11)+N(15))*N(4) IF N(18)-N(9)<0 N(9)=N(18)
0340  N(17)=N(17)-N(8) N(18)=N(18)-N(9)
0350  G$=MID$(C$,39) C$=LEFT$(C$,24)+LEFT$(STR$(N(17))+O$,7)
0360  C$=C$+LEFT$(STR$(N(18))+O$,7)+G$ REWRITE #12
0370 IF N(0)<>1 THEN 400
0380  D$=LEFT$(D$,65)+"00000000000000000000000000000000000"
0390  G$=MID$(E$,15) E$="00000000000000"+G$
0400  G$=LEFT$(D$,65)
```

```
9060 ? #Z,Y1:?#Z,TAB(53);"FOR PERIOD ENDED ";H$(6):?#Z
9070 ? #Z,"  EMP.#  NAME";TAB(41);"GROSS WAGES      FED.     STATE    ";
9080 ? #Z,"FICA     NET PAY BEFORE   MISC.      NET PAY"
9090 ? #Z,TAB(57);"W/H.       W/H.";TAB(82);"MISC. DEDUCTIONS DEDUCT."
9100 ? #Z:L=11:RETURN
```

PROGRAM 6

```
0010 REM PW-2 BAS WRITTEN 3/25/78 BY DAVE GARDNER
0011 REM ADAPTED BY RANDY JACKSON--PERSONAL COMPUTER PLACE
0020 STRING= 128:LINE=0:?CHR$(26):DIM H$(4),I$(5),A(4)
0022  O$="                                        "
0025  Z=4
0027 INPUT "WHEN THE PRINTER IS READY PRESS 'RETURN'",A$:?CHR$(26)
0030  I$="A1BC2D":S$="*******************************************************"
0040  S$=S$+"*****************************************************"
0041  I$(0)="  I.R.S. CENTER "
0042  I$(1)="  CITY OR STATE "
0043  I$(2)="  EMP. FEDERAL   "
0044  I$(3)="   EMPLOYEE      "
0045  I$(4)="   EMP. STATE    "
0046  I$(5)="    EMPLOYER     "
0050 OPEN #10, MASTER FOR INPUT
0060 FIELD #10, A$=92,B$=104,C$=59
0070 GET #10:CLOSE #10:X$=RIGHT$(C$,8):H$(0)=MID$(A$,7,46)
0080  H$(1)=MID$(A$,53):H$(2)=LEFT$(B$,40)
0090  H$(3)=MID$(B$,41,32):H$(4)=MID$(B$,73)
0092 FOR X=0 TO 4:FORY=LEN(H$(X))TO 1 STEP-1
0094 IF " "=MID$(H$(X),Y,1) NEXT Y
0096  H$(X)=LEFT$(H$(X),Y):NEXT X
0100 FOR X=0 TO 3:H$(X)=LEFT$(O$,22-LEN(H$(X))/2)+H$(X)
0105  H$(X)=LEFT$(H$(X)+O$,45):NEXT X
0110 OPEN #11, MASTE1 FOR INPUT
0120 FIELD #11, A$=87,B$=96,C$=72
0130 GET #11:CLOSE #11:N1=VAL("0"+MID$(A$,51,3))
0140 OPEN #12, PERFIL FOR INPUT
0150 FIELD #12, A$=103,B$=103,C$=49
0160 OPEN #13, EMPHST FOR INPUT
0170 FIELD #13, D$=100,E$=104,F$=51
0180 FOR X=1 TO N1
0190 GET #12:GET #13
0200  E$(0)="  "+MID$(B$,2,11)+"  "
0210  A(0)=VAL("0"+MID$(F$,10,7)):A(1)=VAL("0"+MID$(F$,38,7))
0220  A(2)=VAL("0"+MID$(F$,24,7)):A(3)=VAL("0"+MID$(E$,96))
0230  A(3)=A(3)+VAL("0"+LEFT$(F$,7))+VAL("0"+MID$(F$,31,7))
0240  A(4)=VAL("0"+MID$(F$,17,7)):E$(1)=MID$(A$,6,32)
0250  E$(2)=MID$(A$,38,30):E$(3)=MID$(A$,68,30)
0260 FOR X1=1 TO 3:FOR Y=LEN(E$(X1)) TO 1 STEP-1
0262 IF MID$(E$(X1),Y,1)=" " NEXT Y
0265  E$(X1)=LEFT$(O$,15-Y/2)+LEFT$(E$(X1),Y)
0270  E$(X1)=LEFT$(E$(X1)+O$,31):NFXT X1
0280 FOR X1=1 TO LEN(I$)
0290 ? #Z:?#Z,TAB(5);"*";TAB(36);"*";TAB(50);"WAGF AND TAX STATEMENT";
0300 ? #Z,""   19";RIGHT$(X$,2):?$Z,TAB(5);"*";TAB(36);"*"
0310 ? #Z,TAB(5);LFFT$(S$,74):?#Z,TAB(5);"*";H$(0);"EMPLOYERS * COPY";
0320 ? #Z," ";MID$(I$,X1,1);"    FOR    *":?#Z,TAB(5);"*";H$(1);"  NAMF";
0330 ? #Z,"     *";I$(X1-1);"*":?#Z,TAB(5);"*";H$(2);"    &       ";
0340 ? #Z,LFFT$(S$,18):?#Z,TAB(5);"*";H$(3);" ADDRESS   *";H$(4);
0345 ? #Z,TAB(78);"*"
0350 ? #Z,LEFT$(S$,78):?#Z,TAB(5);"*EMPLOYEE S.S.  #*FED. INCOME TAX*";
0360 ? #Z,"COMPENSATION *FICA WITHHELD*TOTAL WAGES *":?#Z,TAB(5);"*";
0370 DIGITS= 2:?#Z,E$(0);"*";RIGHT$(O$+STR$(A(0)),15);"*"
0375 DIGITS= 0:A1=A(1):L=13+GOSUB 8000
0380 ? #Z,"*";:A1=A(2):GOSUB 8000
0390 ? #Z,"*";:A1=A(3):L=12:GOSUB 8000
0400 ? #Z,"*":?#Z,LEFT$(S$,78):?#Z,TAB(5);"*";TAB(15);"EMPLOYEE";
0410  H$=MID$(D$,66,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(10))+O$,7)
0420  H$=MID$(D$,73,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(11))+O$,7)
0430  H$=MID$(D$,80,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(12))+O$,7)
0440  H$=MID$(D$,87,7):G$=G$+LFFT$(STR$(VAL("0"+H$)+N(13))+O$,7)
0450  H$=MID$(D$,94):D$=G$+LEFT$(STR$(VAL("0"+H$)+N(14)),7)
0460  H$=LFFT$(E$,7):G$=LEFT$(STR$(VAL("0"+H$)+N(15))+O$,7)
0470  H$=MID$(E$,8,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(16))+O$,7)
0480  E$=MID$(E$,15):E$=G$+E$
0490 IF N(1)<>1 THEN 530
0500  G$=MID$(E$,82): E$=LEFT$(E$,14)
0510  E$=E$+"000000000000000000000000000000000000000000000000000000000000000"
0520  E$=E$+"000000"+G$
0530  G$=LFFT$(E$,14)
0540  H$=MID$(E$,15,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(8))+O$,7)
0550  H$=MID$(E$,22,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(9))+O$,7)
0560  H$=MID$(E$,29,8):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(10))+O$,8)
0570  H$=MID$(E$,37,8):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(11))+O$,8)
0580  H$=MID$(E$,45,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(12))+O$,7)
0590  H$=MID$(E$,52,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(13))+O$,7)
0600  H$=MID$(E$,59,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(14))+O$,7)
0610  H$=MID$(E$,66,8):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(15))+O$,8)
0620  H$=MID$(E$,74,8):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(16))+O$,8)
0630  H$=MID$(E$,82):E$=G$+H$
0640 IF N(2)<>1 THEN 680
0650  E$=LEFT$(E$,81)+"00000000000000000000000"
0660  G$=MID$(F$,45)
0670  F$="0000000000000000000000000000000000000000000000"+G$
0680  H$=MID$(E$,82,7):G$=LEFT$(STR$(VAL("0"+H$)+N(8))+O$,7)
0690  H$=MID$(E$,89,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(9))+O$,7)
0700  H$=MID$(E$,96):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(10))+O$,9)
0710  E$=LEFT$(E$,81)+G$
0720  H$=MID$(F$,1,9):G$=LEFT$(STR$(VAL("0"+H$)+N(11))+O$,9)
0730  H$=MID$(F$,10,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(12))+O$,7)
0740  H$=MID$(F$,17,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(13))+O$,7)
0750  H$=MID$(F$,24,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(14))+O$,7)
0760  H$=MID$(F$,31,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(15))+O$,7)
0770  H$=MID$(F$,38,7):G$=G$+LEFT$(STR$(VAL("0"+H$)+N(16))+O$,7)
0780  H$=MID$(F$,45):F$=G$+H$
0790 REWRITE #13
0795 NFXT X
0800 CLOSE #12,#13:CHAIN PCHK
0810 END
```

PROGRAM 8

```
0001 REM MAIN BAS WRITTEN 1/78 BY DAVE GARDNER
0002 LINE= 0
0005  O$="                                        ":REM 40 SPACES
0010 PRINT CHR$(26)
0020 PRINT "DO YOU WISH TO: "
0025 ?
0040 DATA "ADD EMPLOYEES"
0070 DATA "EDIT EXISTING EMPLOYEE RECORDS"
0080 DATA "INITIATE PAYROLL RUN"
0090 DATA "CONTINUE PAYROLL RUN"
0100 DATA "PRINT A LISTING OF ALL EMPLOYEES"
0103 DATA "PRINT W-2 FORMS"
0105 DATA "CHANGE EMPLOYEES HISTORY"
0110 DATA "PRINT HISTORICAL REPORT"
0115 DATA "BUILD F.I.T. WITHHOLDING TABLES"
0231 DATA ""
0235 READ D$:IF D$="" THEN 240
0237  C=C+1:?LEFT$(STR$(C)+" "+D$+O$,39);:IF C/2=INT(C/2) ?
0238 GOTO 235
0240 ?:?:?
0250 PRINT "SELECTION";:INPUT A
```

```
0260 IF A<1 THEN 20
0270 IF A>9 THEN 20
0280 IF A<>INT(A) THEN 20
0290 ON A GOTO 310,320,330,340,350,360,370,380,390,400,410,420
0300 ON A-11 GOTO 430,440,450,460,470,480,490,500,510,520
0310 CHAIN ADEM
0320 CHAIN CHEM
0330 CHAIN STRT
0340 CHAIN TAXS
0350 CHAIN PREM
0360 CHAIN PW-2
0370 CHAIN CHHS
0380 CHAIN HSTY
0390 CHAIN TBLE
0520 END
```

PROGRAM 9

```
0010 REM CHEM.BAS WRITTEN 3/14/78 BY DAVE GARDNER
0020 STRING= 128:?CHR$(26):DIM E$(3),D$(2):LINE=0
0025  O$="                                 "
0030 OPEN #12, PERFIL FOR UPDATE
0040 FIELD #12, A$=103, B$=103, C$=49
0050 OPEN #11, MASTE1 FOR INPUT
0060 FIELD #11, A$=100, B$=100, C$=55
0070 GET #11:CLOSE#11:N1=VAL("0"+MID$(A$,51,3))
0080 DATA "1006037EMPLOYEE NAME"
0090 DATA "1038067STREET ADDRESS"
0100 DATA "1068097CITY,STATE,& ZIP"
0110 DATA "1098103DEPARTMENT#"
0120 DATA "2001001MARITAL STATUS (S OR M)"
0130 DATA "2002012SOCIAL SECURITY #"
0140 DATA "2013013PAY CODE (W,S, OR C)"
0150 DATA "2014014WORK STATUS (A OR T)"
0160 DATA "2015022DATE OF HIRE"
0165 DATA "2023030LAST DATE PAID"
0170 DATA "2031038DATE OF BIRTH"
0180 DATA "2039039DED. CALC. CODE (0,1,2,S, OR E)"
0190 DATA "2040046PAY RATE"
0200 DATA "2047053$0"
0210 DATA "2054060$1"
0220 DATA "2061067$2"
0230 DATA "2068074SPECIAL DEDUCTION AMOUNT"
0240 DATA "2075081STATE W/H RATE IN %"
0250 DATA "2082088SPECIAL W/H FIELD"
0260 DATA "2089096DATE OF LAST RATE CHANGE"
0270 DATA "3021022# OF EXEMPTIONS CLAIMED"
0280 DATA "3023023OCCUPATIONAL RISK CATEGORY"
0290 DATA "3024029FUTA LIABILITY THIS PERIOD"
0291 DATA "2097103# OF REGULAR HOURS"
0292 DATA "3001007# OF OVERTIME HOURS"
0295 DATA "3008014AMOUNT OF BONUS"
0296 DATA "3015021AMOUNT OF EXPENSE REIMB "
0300 DATA "3030035SUTA LIABILITY THIS PERIOD"
0305 DATA ""
0310  D$(0)=LEFT$(B$,19):D$(0)=MID$(A$,88)+D$(0)
0320  D$(1)=MID$(B$,20,32):D$(2)=MID$(B$,52,32)
0325 FOR X=0 TO 2:FOR Y=LEN(D$(X)) TO 1 STEP-1
0330 IF MID$(D$(X),Y,1)=" " NEXT Y
0335  D$(X)=LEFT$(D$(X),Y):NEXT X
0340 ? CHR$(26)
0350 INPUT "EMPLOYEE # TO CHANGE (0 TO EXIT)",A
0360 IF A=0 THEN 680
0370 IF A>N1 GOTO 440
0380 SET #12=A:GET #12:A1=VAL("0"+LEFT$(A$,5))
0390 IF A1=A THEN 450
0410  X1=X1+X2:GOTO430
```

```
0202 ? " IN  OUT":?"HHMMHHMM":?:?"ENTER 'RETURN' TO EXIT":?:?
0210 INPUT D$:X1=VAL("0"+LEFT$(D$,4)):IF X1>2400 THEN 280
0215 IF D$="" THEN 310
0220  X2=VAL("0"+MID$(D$,5,4)):IF X2<2401 THEN 290
0280 ? "ILLEGAL INPUT"+CHR$(7):GOTO 210
0290 IF X2<X1 X1=X1-2400
0300  T=T+(X2-X1)/100:GOTO 210
0310 IF T>H T1=T-H:T=H
0311 IF T=0 THEN 440
0315 ? "REGULAR HOURS",T:?"OVERTIME HOURS",T1
0320  B$=LEFT$(B$,96)+STR$(T):C$=LEFT$(STR$(T1)+"       ",7)+MID$(C$,8)
0330 GOTO 420
0340 IF MID$(T$,2,1)<>"1" THEN 440
0350 GOTO 420
0360 IF MID$(T$,2,1)<>"1" THEN 440
0370 GOTO 420
0380 IF MID$(T$,3,1)<>"1" THEN 440
0390 ? CHR$(26);"EMP. #"; LEFT$(A$,37)
0400 ? "COMMISSION";:INPUT T:D$=MID$(B$,47)
0410  B$=LEFT$(B$,39)+LEFT$(STR$(T)+"       ",7)+D$
0420  D$=MID$(B$,31):B$=LEFT$(B$,22)+X$+D$
0430 REWRITE #12
0440 NEXT X
0450 CLOSE #12:CHAIN MAIN
```

PROGRAM 11

```
0010 REM PREM.BAS WRITTEN 3/20/78 BY DAVE GARDNER
0015  Z=4
0020 STRING= 128:LINE=0:?CHR$(26):DIM H$(5),D$(2)
0022  O$="                   "
0025 INPUT "WHEN THE PRINTER IS READY PRESS 'RETURN'",A$:?CHR$(26)
0030 OPEN #11, MASTE1 FOR INPUT
0040 FIELD #11, A$=119,B$=96,C$=40
0050 GET #11:CLOSE#11:N1=VAL("0"+MID$(A$,51,3))
0051  T$=LEFT$(C$,39)
0053 OPEN #12, PERFIL FOR INPUT
0055  D$(0)=MID$(A$,88):D$(1)=LEFT$(B$,32)
0056  D$(2)=MID$(B$,33,32)
0057 FIELD #12, A$=103, B$=103, C$=49
0060 OPEN #10, MASTER FOR INPUT
0070 FIELD #10, A$=92, B$=104, C$=59
0080 GET #10: CLOSE#10:H$(0)=MID$(A$,7,46):H$(1)=MID$(A$,53)
0085  X$=RIGHT$(C$,8)
0090  H$(2)=LEFT$(B$,40):H$(3)=MID$(B$,41,32):H$(4)=MID$(B$,73)
0100 LET H$(5)="REPORT OF EMPLOYEES AS OF "+X$
0105 FOR X=0 TO 2:FOR Y=LEN(D$(X)) TO 1 STEP-1
0110 IF MID$(D$(X),Y,1)="0" NEXT Y
0113  D$(X)=LEFT$(D$(X),Y):NEXT X
0120  L1=66:P=0:GOSUB 9000
0140 FOR X=1 TO N1:GET#12
0150 ? #Z, LEFT$(A$,5);" ";MID$(A$,6,32);"   ";
0160 IF LEFT$(B$,1)="M" ?#Z,"MARRIED";:GOTO 180
0170 ? #Z, "SINGLE ";
0180 ? #Z, "      ";MID$(B$,23,8);"    ";MID$(B$,31,8);
0190  A=VAL("0"+MID$(B$,47,7))
0195 DIGITS= 2:?#Z,"   ";RIGHT$(O$+STR$(A),15);"   ";D$(0);:DIGITS=0
0200 ? #Z,TAB(127);MID$(C$,24,1)
0210 ? #Z,TAB(7);MID$(A$,38,30);"     ";
0220  Q$=MID$(B$,13,1):IF Q$="C" THEN 250
0225 IF Q$="S" THEN 240
0230 ? #Z,"HOURLY     ";:GOTO260
0240 ? #Z,"SALARY     ";:GOTO260
0250 ? #Z,"COMMISSION";
0260 IF MID$(B$,14,1)="A" ?#Z,"  ACTIVE   ";:GOTO280
0270 ? #Z,"TERMINATED";
0280  D$=MID$(B$,39,1)
```

```
0440 ? "EMPLOYEE NOT FOUND":GOTO 350
0450  E$(1)=A$:E$(2)=B$:E$(3)=C$
0460 RESTORE :? CHR$(26):C=0
0470 READ A$:IF A$="" ?:?:GOTO 530
0480  C=C+1:?C;:IF MID$(A$,8,1)="$" THEN 500
0490 ? MID$(A$,8);:GOTO 510
0500 ? D$(VAL(MID$(A$,9)));
0510 IF C/2=INT(C/2) ?:GOTO 470
0520 ? TAB(40);:GOTO 470
0530 ? "EMPLOYEE # ";LEFT$(E$(1),5);"      ";MID$(E$(1),6,32)
0535 INPUT "ITEM # TO CHANGE (0 TO EXIT)",A
0540 IF A=0 THEN 670
0550 IF A>0 IF A<C IF A=INT(A) THEN 570
0560 GOTO 530
0570 RESTORE :FOR A1=1 TO A:READ A$:NEXT A1
0580 IF MID$(A$,8,1)<>"$" THEN 600
0590  A$=LEFT$(A$,7)+D$(VAL(MID$(A$,9)))
0600 ? "THE ";MID$(A$,8);" WAS ";
0610  P8=VAL(LEFT$(A$,1)):K$=E$(P8):P8=VAL(MID$(A$,2,3))
0613  L$=MID$(A$,5,3):M$=MID$(A$,2,3)
0615 ? MID$(K$,P8,VAL(L$)-VAL(M$)+1)
0620 INPUT "IT WILL NOW BE", B$
0630  L$=LEFT$(A$,1):M$=MID$(A$,2,3):C$=LEFT$(E$(VAL(L$)),VAL(M$)-1)
0640  M$=MID$(A$,5,3):D$=MID$(E$(VAL(L$)),VAL(M$)+1)
0650  B$=LEFT$(B$+O$,VAL(MID$(A$,5,3))-VAL(MID$(A$,2,3))+1)
0660  E$(VAL(LEFT$(A$,1)))=C$+B$+D$:GOTO 8000
0670  A$=E$(1):B$=E$(2):C$=E$(3):REWRITE #12:GOTO 340
0680 CLOSE #12:CHAIN MAIN
8000  A9=(C+1)/2+3
8010 ? CHR$(27);"=";CHR$(31+A9);" ";
8020 FOR F1=A9 TO 22:?LEFT$(O$+O$,75):NEXT F1
8030 ? CHR$(27);"=";CHR$(31+A9);" ";
8040 GOTO 530
```

PROGRAM 10

```
0010 REM PINP.BAS WRITTEN 3/15/78 BY DAVE GARDNER
0011 REM ADAPTED BY RANDY JACKSON--PERSONAL COMPUTER PLACE
0020 STRING= 128:LINE=80:?CHR$(26)
0022 OPEN #10, MASTER FOR INPUT
0025 FIELD #10,A$=100,B$=100,C$=55
0028 GET #10:X$=RIGHT$(C$,8):CLOSE#10
0030 OPEN #11, MASTE1 FOR INPUT
0040 FIELD #11, A$=119, B$=93, C$=43
0050 GET #11:CLOSE #11:T$=MID$(B$,84,6):N1=VAL("0"+MID$(A$,51,3))
0053 IF LEFT$(T$,1)<>"1" THEN 60
0055 INPUT "NUMBER OF HOURS IN WORKING WEEK",H
0060 OPEN #12, PERFIL FOR UPDATE
0070 FIELD #12, A$=103, B$=103, C$=49
0080 FOR X=1 TO N1
0082 GET #12
0084 IF MID$(B$,14,1)="T" THEN 440
0086  D$=MID$(B$,13,1)
0090 IF D$="W" THEN 160
0100 IF D$="S" THEN 340
0110 IF D$="M" THEN 360
0120 IF D$="C" THEN 380
0130 ? "ILLEGAL PAY CODE ON EMPLOYEE #";LEFT$(A$,5)
0140 ? "CONTINUE";:INPUT A$:IF ASC(A$)=89 THEN 160
0150 STOP
0160 IF LEFT$(T$,1)<>"1" THEN 440
0165 ? :?:?"EMP. #";LEFT$(A$,37)
0170  T=0:INPUT "SUBMIT BY TIME CARD OR TOTAL (C OR T)",D$
0175  T1=0
0180 IF D$="T" INPUT "TOTAL HOURS WORKED ",T:GOTO 310
0190 IF D$<>"C" GOTO 170
0200 ? "ENTER TIME CARD DATA IN THE FOLLOWING FORMAT:":?
```

```
0290 IF D$="S" D$="":GOTO 320
0300 IF D$="E" D$="":GOTO 320
0310  A=VAL("0"+D$):D$=MID$(T$,A*13+1,13)
0320  A=VAL("0"+MID$(B$,54,7))
0330 DIGITS= 2:?#Z,TAB(74);RIGHT$(O$+STR$(A),15);
0335 ? #Z,TAB(91);D$(1):DIGITS=0
0340 ? #Z,TAB(7);MID$(A$,68,30);"    ";MID$(B$,2,11);"   ";MID$(B$,23,8);
0350  A=VAL("0"+MID$(B$,40,7)):DIGITS=2:D$=RIGHT$(O$+STR$(A),15):DIGITS=0
0360 ? #Z,TAB(64);RIGHT$(D$,10);:A=VAL("0"+MID$(B$,61,7))
0370 DIGITS= 2:?#Z,RIGHT$(O$+STR$(A),15);:DIGITS=0
0375 ? #Z,"   ";D$(2);"   ";TAB(127);MID$(C$,22,2):?#Z
0380  L=L+4:IF L>58 GOSUB 9000
0390 NEXT X
0400 CLOSE #12:CHAIN MAIN
9000 ? #Z, CHR$(12):P=P+1:?#Z," PAGE ";P
9010 ? #Z,TAB(L1-LEN(H$(0))/2);H$(0):?#Z," FED  EMP #  ";
9020 ? #Z,H$(3);TAB(L1-LEN(H$(1))/2);H$(1)
9030 ? #Z," STATE EMP # ";H$(4);TAB(L1-LEN(H$(2))/2);H$(2)
9040 ? #Z,TAB(L1-LEN(H$(5))/2);H$(5):?#Z
9050 ? #Z,TAB(40);"MAR. STAT.   DATE HIRED  D.O.B.";
9060 ? #Z,"          DEDUCTIONS       DEDUCTIONS";LEFT$(O$+O$,22);"OCC RISK"
9070 ? #Z,"EMP. # NAME & ADDRESS";TAB(40);"S.S.  #";
9080 ? #Z,TAB(52);"LAST PAID    PAY RATE";TAB(79);
9090 ? #Z,"AMOUNT";TAB(95);"TITLE";LEFT$(O$+O$,24);"ALLOW
9100 ? #Z:L=10:RETURN
```

PROGRAM 12

```
0010 REM CH10.BAS WRITTEN 3/23/78 BY DAVE GARDNER
0020 STRING= 128:?CHR$(26):DIM E$(3),D$(2):LINE=0
0025  O$="
0030 OPEN #12, MASTER FOR UPDATE
0040 FIELD #12, A$=92,B$=104,C$=59
0080 DATA "1007052COMPANY NAME"
0090 DATA "1053092COMPANY ADDRESS"
0100 DATA "2001040CITY,STATE, & ZIP"
0110 DATA "2041072FEDERAL EMPLOYER #"
0120 DATA "2073104STATE EMPLOYER #"
0130 DATA "3001042BANK NAME"
0140 DATA "3043051FIRST CHECK #"
0305 DATA ""
0310  D$(0)=LEFT$(B$,19):D$(0)=MID$(A$,88)+D$(0)
0315  D$(1)=MID$(B$,20,32):D$(2)=MID$(B$,52,32)
0320 FOR X=0 TO 2:FOR Y=LEEN(D$(X)) TO 1 STEP-1
0325 IF MID$(D$(X),Y,1)=" " NEXT Y
0330  D$(X)=LEFT$(D$(X),Y):NEXT X
0340 ? CHR$(26)
0410 GET #12
0450  E$(1)=A$:E$(2)=B$:E$(3)=C$
0460 RESTORE :? CHR$(26):C=0
0470 READ A$:IF A$="" THEN 530
0480  C=C+1:?C;:IF MID$(A$,8,1)="$" THEN 500
0490 ? MID$(A$,8);:GOTO 510
0500 ? D$(VAL(MID$(A$,9)));
0510 IF C/2=INT(C/2) ?:GOTO 470
0520 ? TAB(40);:GOTO 470
0530 ? :?:INPUT "ITEM# TO CHANGE (0 TO EXIT)",A
0540 IF A=0 THEN 670
0550 IF A>0 IF A<C+1 IF A=INT(A) THEN 570
0560 GOTO 530
0570 RESTORE :FOR A1=1 TO A:READ A$:NEXT A1
0580 IF MID$(A$,8,1)<>"4" THEN 600
0590  A$=LEFT$(A$,7)+D$(VAL(MID$(A$,9)))
0600 ? "THE ";MID$(A$,8);" WAS ";
0610  P8=VAL(LEFT$(A$,1)):K$=E$(P8):P8=VAL(MID$(A$,2,3))
0613  L$=MID$(A$,5,3):M$=MID$(A$,2,3)
0615 ? MID$(K$,P8,VAL(L$)-VAL(M$)+1)
```

```
0620 INPUT "IT WILL NOW BE", B$
0630  L$=LEFT$(A$,1):M$=MID$(A$,2,3):C$=LEFT$(E$(VAL(L$)),VAL(M$)-1)
0640  M$=MID$(A$,5,3):D$=MID$(E$(VAL(L$)),VAL(M$)+1)
0650  K$=LEFT$(O$,VAL(MID$(A$,5,3))-VAL(MID$(A$,33))+1-LEN(B$)
0655  B$=B$+K$
0660  E$(VAL(LEFT$(A$,1)))=C$+B$+D$:GOTO0460
0670  A$=E$(1):B$=E$(2):C$=E$(3):REWRITE #12
0680 CLOSE #12:CHAIN MAIN
```

PROGRAM 13

```
0010 REM CH11 BAS WRITTEN 3/23/78 BY DAVE GARDNER
0020 STRING= 128 ?CHR$(26):DIM E$(3):LINE=0
0022  O$="                                        "
0030 DIM F$(25):C=0
0040 READ A$:IF A$<>"" F$(C)=A$:C=C+1:GOTO 40
0050 FOR X=0 TO C-1
0060  G$=LEFT$(STR$(X+1)+"  "+O$,5)+MID$(F$(X),8):G$=LEFT$(G$+O$,39)
0070  G$(X/2)=G$(X/2)+G$:NEXT X
0080 OPEN #12, MASTE1 FOR UPDATE
0090 FIELD #12, A$=87,B$=96,C$=72
0100 DATA "1007038BANK ADDRESS"
0110 DATA "1039044LAST EMPLOYEE #"
0120 DATA "1045050# OF PAYROLLS RAN YTD"
0130 DATA "1051053# OF EMPLOYEES ON FILE"
0140 DATA "1054060CUMULATIVE FICA WITHHELD"
0150 DATA "1061067CUMULATIVE FIT  WITHHELD"
0160 DATA "1068074CUMULATIVE SIT  WITHHELD"
0170 DATA "1075080CHECK CHARGING RATE"
0180 DATA "1081087# OF CHECKS PRODUCED MTD"
0190 DATA "2001032DEDUCTION #1 TITLE"
0200 DATA "2033064DEDUCTION #2 TITLE"
0210 DATA "2065096DEDUCTION #3 TITLE"
0220 DATA "3002010PERIOD ENDING DATE"
0230 DATA "3059071TABLE #3 TITLE"
0240 DATA "3011019CURRENT CHECK DATE"
0250 DATA "3033045TABLE #1 TITLE"
0260 DATA "3026032FEDERAL FIT,FICA DEPOSIT LIMIT"
0270 DATA "3046058TABLE #2 TITLE"
0280 DATA "3020025CURRENT PAYROLL TYPE (123MQY)"
0290 DATA ""
0300 GET #12
0310  E$(1)=A$:E$(2)=B$:E$(3)=C$
0320 ? CHR$(26)
0330 FOR X=0 TO C/2:? G$(X):NEXT X
0340 ? :?:INPUT "ITEM# TO CHANGE (0 TO EXIT)",A
0350 IF A=0 THEN 500
0360 IF A>0 IF A<C+1 IF A=INT(A) THEN 380
0370 GOTO 340
0380  A1=A:A$=F$(A1-1)
0390 IF MID$(A$,8,1)<>"4" THEN 410
0400  A$=LEFT$(A$,7)+D$(VAL(MID$(A$,9)))
0410 ? "THE ";MID$(A$,8);" WAS ";
0420  P8=VAL(LEFT$(A$,1)):K$=E$(P8):P8=VAL(MID$(A$,2,3))
0430  L$=MID$(A$,5,3):M$=MID$(A$,2,3)
0440 ? MID$(K$,P8,VAL(L$)-VAL(M$)+1)
0450 INPUT "IT WILL NOW BE", B$
0460  L$=LEFT$(A$,1):M$=MID$(A$,2,3):C$=LEFT$(E$(VAL(L$)),VAL(M$)-1)
0470  M$=MID$(A$,5,3):D$=MID$(E$(VAL(L$)),VAL(M$)+1)
0480  B$=LEFT$(B$+O$,VAL(MID$(A$,5,3))-VAL(MID$(A$,2,3))+1)
0490  E$(VAL(LEFT$(A$,1)))=C$+B$+D$:GOTO0320
0500  A$=E$(1):B$=E$(2):C$=E$(3)
0510 REWRITE #12
0520 CLOSE #12:CHAIN MAIN
0010 REM INIT BAS WRITTEN 3/14/78 BY DAVE GARDNER
0015 STRING= 128
0310 FIELD #13, A$=100,B$=104,C$=51
0320 FOR X=0 TO 8:READ D$(X):NEXT X
0330 ? CHR$(26)
0340 INPUT "EMPLOYEE # (0 TO EXIT)",A
0350 IF A=0 THEN 610
0360  X1=N1/2:X2=X1/2
0370 SET #12=X1:GET#12:A1=VAL(LEFT$(A$,5))
0380 IF A1=A THEN 440
0390 IF A1>A THEN 410
0400  X1=X1+X2: GOTO 420
0410  X1=X1-X2
0420  X2=X2/2:IF X2>.2 THEN 370
0430 ? CHR$(7);"EMPLOYEE NOT FOUND":GOTO 340
0440  A1=LOC#12:SET#13=A1:GET#13:G$(0)=A$:G$(1)=B$:G$(2)=C$
0450 ? CHR$(26);"DO YOU WISH TO CHANGE":?
0460 FOR X=0 TO 3:? X+1;TAB(5);E$(X);" INFORMATION":?: NEXT X:?
0470 INPUT "SELECTION (0 TO EXIT)",A:IF A=0 THEN 600
0480 IF A>0 IF A<5 IF A=INT(A) THEN 495
0490 GOTO 470
0495  A=A-1
0500 ? CHR$(26);"DO YOU WISH TO CHANGE":?
0510 FOR X=1 TO LEN(F$(A))/8
0520 ? X;TAB(5);E$(A);" ";D$(VAL(MID$(F$(A),X*8-7,1))):NEXT X
0530 ? :INPUT "SELECTION (0 TO EXIT)",A1:IF A1=0 THEN 450
0540  D$=E$(A)+" "+D$(VAL(MID$(F$(A),A1*8-7,1)))
0550  X1=VAL(MID$(F$(A),A1*8-5,3)):X2=VAL(MID$(F$(A),A1*8-2,3))
0560  X3=VAL(MID$(F$(A),A1*8-6,1)):?"THE ";D$;" WAS ";
0570 ? MID$(G$(X3),X1,X2-X1+1):INPUT "IT WILL NOW BE",A$
0580  A$=LEFT$(A$+O$,X2-X1+1):B$=LEFT$(G$(X3),X1-1)
0590  C$=MID$(G$(X3),X2+1):G$(X3)=B$+A$+C$:GOTO 500
0600  A$=G$(0):B$=G$(1):C$=G$(2):REWRITE #13:GOTO 330
0610 CLOSE #12:#13:CHAIN MAIN
```

PROGRAM 16

```
0010 REM PWR1 BAS WRITTEN 3/22/78 BY DAVE GARDNER
0020 STRING= 128 LINE=0 ?CHR$(26):Z=0:P=0:L1=66
0022  O$="                                        "
0023 LINE= 0
0025  Z=4
0026 INPUT "WHEN THE PRINTER IS READY PRESS 'RETURN'",A$
0027 ? CHR$(26)
0030 OPEN #10, MASTER FOR INPUT
0040 FIELD #10, A$=92, B$=104, C$=59
0050 GET #10:CLOSE #10:DIM H$(6),T(5)
0060  H$(0)=MID$(A$,7,46):H$(1)=MID$(A$,53,40)
0070  H$(2)=LEFT$(B$,40):H$(3)=MID$(B$,41,32)
0080  H$(4)=MID$(B$,73)
0085  X$=RIGHT$(C$,8)
0090 OPEN #11, MASTE1 FOR INPUT
0100 FIELD #11, A$=119, B$=96, C$=40
0110 GET #11:CLOSE#11:H$(5)=X$:H$(6)=MID$(B$,66,8)
0120  N1=VAL("0"+MID$(A$,51,3)):Y1=VAL("0"+MID$(A$,45,6))
0130 OPEN #12, PERFIL FOR INPUT
0140 FIELD #12, A$=103, B$=103, C$=49
0150 OPEN #13, EMPHST FOR INPUT
0160 FIELD #13, D$=100, E$=104, F$=51
0170 GOSUB 9000
0180 FOR X=1 TO N1:GET#12:IF MID$(B$,23,8)<>X$ THEN 320
0190 GET #13:FOR X1=5TO1 STEP-1:IFMID$(A$,X1,1)=" " NEXT X1
0195  G$=LEFT$(A$,X1)
0200 ? #Z,RIGHT$(O$+G$,6);"   ";MID$(A$,6,32);
0210  A=VAL("0"+MID$(B$,13,1)):ON A+1 GOTO 220,230,240
0220  A=VAL("0"+MID$(B$,97))+VAL("0"+LEFT$(C$,7)):G$=STR$(A):GOTO 250
0230  G$="SALARY":GOTO 250
0240  G$="COMISN"
```

```
0017 LET O$="                                        ":REM 40 SPACES
0020 CREATE MASTER REC=255,FILE=1
0030 OPEN #10, MASTER FOR UPDATE
0040 FIELD #10, A$=100,B$=100, C$=55
0050 GET #10:A$="PAYROL":REWRITE #10:CLOSE#10
0080 CREATE MASTE1 REC=255,FILE=1
0090 CREATE PERFIL REC=255,FILE=300
0100 CREATE EMPHST REC=255,FILE=300
0110 OPEN #11, MASTE1 FOR UPDATE
0120 FIELD #11, A$=100,B$=100,C$=55
0130 GET #11:A$="PAYROO"+LEFT$(""+O$,32)+"000000000000000"
0140  A$=A$+"00000000000000000000000000000000000"
0150 REWRITE #11:CLOSE#11
0170 CREATE PAYTAB REC=10,FILE=276
0180 CREATE PAYCTL REC=100,FILE=1
0190 CHAIN INI1
```

PROGRAM 14

```
0001 REM START  ---- BY DAVE GARDNER ----
0010 STRING= 128:LINE=0
0020 OPEN #11, MASTER FOR UPDATE
0030 FIELD #11, A$=100,B$=100,C$=55
0040 ? CHR$(26):GET #11
0050 ?  INPUT "PLEASE ENTER IN TODAY'S DATE (MM/DD/YY)",Q$
0060 IF MID$(Q$,3,1)<>"/" THEN 50
0070 IF MID$(Q$,6,1)<>"/" THEN 50
0080  M=VAL("0"+Q$):D=VAL("0"+MID$(Q$,4)):Y=VAL("0"+MID$(Q$,7))
0090 IF M<13 IFM>0 IF D>0 IF D<32 IF LEN(Q$)=8 THEN 110
0100 GOTO 50
0110  C$=LEFT$(C$,47)+Q$
0120 REWRITE #11:CLOSE #11
0130 CHAIN MAIN
```

PROGRAM 15

```
0010 REM CHHS BAS WRITTEN 3/14/78 BY DAVE GARDNER
0020 STRING= 128:LINE=80:?CHR$(26):DIM D$(8),E$(3),F$(3),G$(2)
0025  O$="                                        "
0030 OPEN #11, MASTE1 FOR INPUT
0040 FIELD #11, A$=100, B$=100, C$=55
0050 GET #11:CLOSE #11:N1=VAL("0"+MID$(A$,51,3))
0060  E$(0)="WEEKLY"
0070  E$(1)="MTD"
0080  E$(2)="QTD"
0090  E$(3)="YTD"
0100 DATA "FUTA"
0110 DATA "SUTA"
0120 DATA "REGULAR PAY IN $"
0130 DATA "OVERTIME PAY IN $"
0140 DATA "FIT"
0150 DATA "SIT"
0160 DATA "FICA"
0170 DATA "BONUS IN $"
0180 DATA "EXPENSE REIMB  IN $"
0190  F$(0)="20001007300080144001502150022028600290035"
0200  F$(1)="20066072300730794008008650087093600094100"
0210  F$(1)=F$(1)+"7100100781008014"
0220  F$(2)="010150211102202821029036310037044"
0230  F$(2)=F$(2)+"41045051510520586105906 5"
0240  F$(2)=F$(2)+"7106607381074081"
0250  F$(3)="010820881108909521096105320010 09"
0260  F$(3)=F$(3)+"420100165201702362024030"
0270  F$(3)=F$(3)+"7203103782038044"
0280 OPEN #12, PERFIL FOR INPUT
0290 FIELD #12, A$=100, B$=100, C$=55
0300 OPEN #13, EMPHST FOR UPDATE
```

```
0250 ? #Z,RIGHT$(O$+G$,8);" ";:T(0)=T(0)+VAL("0"+G$)
0260  A=VAL("0"+LEFT$(D$,7)):G=A:DIGITS=2:G$=RIGHT$(O$+STR$(A),10)
0265  T(1)=T(1)+A
0270  A=VAL("0"+MID$(D$,8,7)):G=G+A:T(2)=T(2)+A
0280 ? #Z,G$;:G$=RIGHT$(O$+STR$(A),10)
0285 ? #Z,G$;
0287  A=VAL("0"+MID$(C$,8,7)):T(3)=T(3)+A
0290  G=G+A:?#Z,RIGHT$(O$+STR$(A),10)+"";
0295 ? #Z,RIGHT$(O$+STR$(G),10)+"";:T(4)=T(4)+G
0300  A=VAL("0"+MID$(C$,15,7)):?#Z,RIGHT$(O$+STR$(A),10);  :?#Z;
0301  T(5)=T(5)+A
0305 DIGITS= 0
0310  L=L+2:IF L>59 GOSUB 9000
0320 NEXT X
0330 FOR X=L TO 59:?#Z:NEXT X
0340 ? #Z,"     TOTALS ";
0345 DIGITS= 0:?#Z,TAB(44);RIGHT$(O$+STR$(T(0)),5);
0347 DIGITS= 2
0350 FOR X=1 TO 5
0352 ? #Z,TAB(X*10+40);RIGHT$(O$+STR$(T(X)),10);
0355 NEXT X:?#Z:DIGITS=0
0360 CLOSE #12,#13:CHAIN PWR2
9000 ? #Z,CHR$(12):P=P+1:?#Z,TAB(11);"PAGE ";P
9010 ? #Z,TAB(L1-LEN(H$(0))/2);H$(0)
9020 ? #Z,"FEDERAL EMPLOYER # :   ";H$(3);TAB(L1-LEN(H$(1))/2);H$(1);
9030 ? #Z,TAB(87);"CHECKS ARE DATED ";H$(5)
9040 ? #Z,"STATE EMPLOYER # :   ";H$(4);TAB(L1-LEN(H$(2))/2);H$(2)
9050 ? #Z,TAB(58);"PAYROLL REGISTER";TAB(87);"YTD PAYROLL # :  ";
9060 ? #Z,Y1:?#Z,TAB(53);"FOR PERIOD ENDED ";H$(6):?#Z
9070 ? #Z,"   EMP.#  NAME";TAB(45);"HOURS    REGULAR    ";
9080 ? #Z,"OVERTIME       BONUS  GROSS WAGES  EXPENSE REIMB. "
9090 ? #Z,TAB(55);"PAY";TAB(66);"PAY";TAB(77);"PAY":?#Z
9100  L=11:RETURN
```

PROGRAM 17

```
0010 REM PWR4 BAS WRITTEN 3/22/78 BY DAVE GARDNER
0011 REM ADAPTED BY RANDY JACKSON--PERSONAL COMPUTER PLACE
0020 STRING= 128 LINE=0:?CHR$(26):Z=0:P=0:L1=66
0022  O$="                    "
0025  Z=4
0030 OPEN #10, MASTER FOR INPUT
0040 FIELD #10, A$=92, B$=104, C$=59
0050 GET #10:CLOSE #10:DIM H$(6),D$(4)
0055  H$(0)=MID$(A$,7,46):H$(1)=MID$(A$,53,40)
0060  H$(2)=LEFT$(B$,40):H$(3)=MID$(B$,41,32)
0065  H$(4)=MID$(B$,73):C1=VAL("0"+MID$(C$,43,9)):X$=RIGHT$(C$,8)
0070 FOR X=1TO4:FORY=LEN(H$(X))TO1STEP-1:IFMID$(H$(X),Y,1)=" "NEXTY
0080  H$(X)=LEFT$(H$(X),Y):NEXT X
0090 OPEN #11, MASTE1 FOR INPUT
0100 FIELD #11, A$=119, B$=96, C$=40
0110 GET #11:CLOSE#11:H$(5)=X$:H$(6)=MID$(B$,66,8)
0113  D$(0)="PAY":D$(1)=MID$(A$,88):D$(2)=LEFT$(B$,32)
0114  D$(3)=MID$(B$,33,32):D$(4)="SPECIAL DEDUCTION"
0115 FOR T=1 TO 4:FORY=LEN(D$(T))TO1 STEP-1
0117 IF MID$(D$(T),4,1)=" "NEXT Y
0118  D$(T)=LEFT$(D$(T),Y)+" ":NEXT T
0120  N1=VAL("0"+MID$(A$,51,3)):Y1=VAL("0"+MID$(A$,45,6))
0130 OPEN #12, PERFIL FOR INPUT
0140 FIELD #12, A$=103, B$=103, C$=49
0150 OPEN #13, EMPHST FOR INPUT
0160 FIELD #13, D$=100, E$=104, F$=51
0170  X1=0:GOSUB 9000
0175 SET #12=1:SET #13=1:T1=0
0180 FOR X=1 TO N1
0185 GET #12:IF MID$(B$,23,8)<>X$ THEN 370
0187 GET #13
```

Branched to Page 106

INTERFACING WITH COMMERCIAL SOFTWARE

By Eric D. Savage

The microcomputer market has experienced a tremendous proliferation of commercial software in the last year. Many of these programs attempt to be extremely general in application—but this means that they are not really suited for specific applications. If the source code was available for these programs, they could be modified to a specific application. But there are two problems inherent in modifying commercial software. First, much (if not most) of the commercial software is being supplied in a machine readable intermediate language (such as the INT files of CBASIC I & II). Second, modifying existing code can be extremely trying as what appears to be a minor change in the code may affect the entire effectiveness of the program.

One answer to customizing commercial software is to create subsidiary programs which duplicate exactly the functions of the entry programs in the commercial software. These programs can then make files that are used by the remaining programs in the commercial software. This method has been used by the author to customize two accounting systems produced by Structured Systems Group for specific applications.

A mail order company desired to use a micro to handle invoicing both for wholesale customers and retail mail order customers who sent in magazine clippings. Some of the requirements of the system were as follows:

- The system had to have the capacity of printing the specific invoice that the company desired.
- The system had to have a single entry point both for the invoicing and for entrance into the mailing list.
- By reading the catalog data into memory, the input of an item number and quantity would enable the unit price, item description, total price, and weight of the item to be determined for printing or processing.
- The checks received were recorded for use in printing a bank deposit slip.
- Shipping charges had to be computed for UPS shipping and US Mail for light packages. The weight of packing materials had to be added into the net weight of the purchases.

In order for this program to effectively interface with Structured Systems Group (SSG) Accounts Receivable programs, the only files which had to be exactly duplicated were the cash batch file and the invoice batch file. SSG supplies in the documentation a complete breakdown of the file structure. Thus the duplication was possible without a major analysis of the file structure. In order to use the name and address program, a file was created by ORDERENT which was in the NAD file format. Each day's customers are moved from the daily new customer file, NEWCUST. NAD, to customer files for mailing list applications.

ORDERENT is presently being used by the mail order company to process both the wholesale orders and the retail mail order requests. A sample of the invoice being used is shown in Figure 1. Among the features of the program are the ability to include standard messages on the invoice and to decode the shipping information. In the case of the example, the shipping code is located directly above the addressee. The first digits indicate the United Parcel Service zone, the next the weight, and the final digits are the UPS charge in cents.

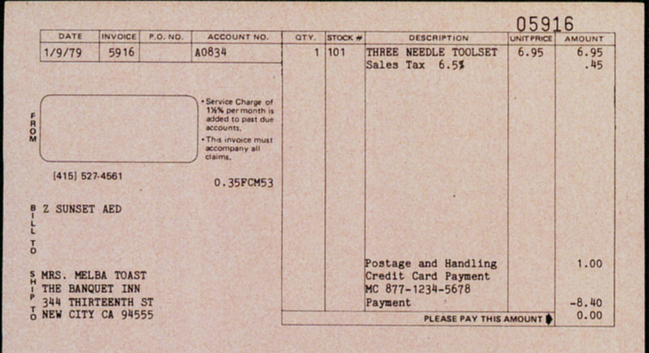
The BILL TO: box is coded with the magazine the response came from. Thus the response to different issues and magazines can be judged so that advertising dollars can be directed to the magazines creating the largest response.

In excess of one hundred orders per day are presently being processed through the computer in a few hours. The single entry point creates the invoice, the audit trail, the mailing list update, the sales report, information on the commissionable sales of wholesale dealers, and the accounts receivable batch.

By using three SUBMIT files, the daily operations needed to maintain the accounts receivable system have been reduced to easily remembered sequences: SUBMIT DAILY; SUBMIT DAILY2; A and SUBMIT NAD. These SUBMIT files are designed to assist the operator by containing the exact program sequences as well as file deletions required.

CHECK WRITING

The second application was the creation of a check writing program which would interface directly with the SSG General Ledger programs. SSG's General Ledger is very effective for producing income statements and balance sheets, but it is somewhat cumbersome for entering data as all items have to be entered separately into the debit and credit accounts. The client desired to have the program automatically debit and credit accounts and print checks including a detailed stub.



05916

DATE	INVOICE	P.O. NO.	ACCOUNT NO.	QTY.	STOCK #	DESCRIPTION	UNIT PRICE	AMOUNT
1/9/79	5916		A0834	1	101	THREE NEEDLE TOOLSET	6.95	6.95
						Sales Tax 6.5%		.45
						Postage and Handling		1.00
						Credit Card Payment		
						MC 877-1234-5678		
						Payment		-8.40
						PLEASE PAY THIS AMOUNT ▶		0.00

FROM

•Service Charge of 1½% per month is added to past due accounts.

•This invoice must accompany all claims.

(415) 527-4561

0.35FCM53

BILL TO
Z SUNSET AED

SHIP TO
MRS. MELBA TOAST
THE BANQUET INN
344 THIRTEENTH ST
NEW CITY CA 94555

Figure 1. Invoice produced by ORDERENT.

Thus if a check was being used to pay several invoices, and expenses were charged to different accounts such as accounts payable and insurance expense, for example, the check printing program could detail all the information on the stub at the same time that it was being credited to the appropriate general ledger accounts.

A listing of CHECKWRT is provided. CHECKWRT is written in CBASIC using the full capabilities of Version I only, and therefore does not contain some of the enhancements that are available in CBASIC II. The compiler listing supplied is the CBASIC II listing. The listing has numerous remarks statements in order to direct the reader as to the function of the various modules. A major advantage of CBASIC is that these remarks do not increase the length of the intermediate language file created by the CBASIC or CBASIC II compile.

The program is designed to be smart in respect to several functions. The date is required to be reasonable, i.e. no 13th months or 30th days in February.

The entire chart of accounts is read into memory so that each account number entered can be verified against the existing accounts. SSG uses this protocol: account numbers ending in zero are heading accounts numbers, which do not have balances associated with them. Therefore, the program treats heading accounts as if they did not exist.

The main program consists of subroutine calls. Thus the program can be modified very easily for a check with the stub on the top, as opposed to the existing design of bottom stubs.

The program logic is designed to write checks up to $20,000. This is for two reasons. First, the length of the space available for writing out the amount in words is limited.

The program design is based upon some intelligence on the part of the operator. The perfect program should be so well designed that even a monkey randomly striking keys should not be able to crash the program. This program, however, assumes that the operator has examined the operator's manual and that the operator has some experience in running computer programs.

The interface with SSG General Ledger is made in the following manner:

1. All SSG General Ledger Data Diskettes have a file called PGLPAR.101 which contains the following information which is needed to operate the files:

Field Name	Position	Remarks
PAR.FILE.SUFFIX$	2	Used to Identify Files
PAR.CO.NAME$	3	Displayed on Screen

2. The PAR.FILE.SUFFIX$ appears as the last two letters of the primary file name on all other files on the General Ledger Data Diskette. Thus the extraction of this data enables the program to open the chart of account file and the invoice batch file.
3. The existence of an invoice batch is checked by using the SIZE function of CBASIC. If the invoice batch exists, the file is opened, if the file does not exist, or if it is an empty file, a new file is created. A message is placed on the screen to that effect.
4. The journal batch is read to the end to move the file pointer to the end of the existing data. Thus new entries will be appended to the file.
5. The chart of accounts file is opened and all the accounts are read into arrays. The program is designed to handle up to 300 accounts (the maximum presently allowed by SSG) in the computer memory.
6. The final interfacing is to print the data to the journal batch file.

When the console displays the prompt requesting the name of the payee, there exist several options for the operator. The program can be terminated by either hitting a return or an escape code sequence (ESC 7), a new payee can be entered, (which is the normal sequence for continued processing) or the parameter change subsystem can be entered by using the escape code sequence (ESC 9).

The parameter change subsystem was created because of a user request. He stated that if he failed to align the checks properly, he definitely did not desire to wait for 250 accounts to be reread from the disk as the program is restarted. The parameter change subsystem therefore allows the following options:

- Changing the check numbering
- Reprinting the check
- Input of a new date
- Charging the number of the cash account

Entrance into the parameter change subsystem is made by using an Escape code sequence (ESC 9) at the time that the console prompts for a new payee.

The writing of the accounting data out to the journal batch is specifically designed for checkwriting operations. The form of the file print statement exactly coincides with that specified by the SSG General Ledger program. The reference field, however, is specially designed. For the detail accounts (i.e. those other than the case account), the reference field consists of the check number and the specific reference entered by the operator. In the event that no definite reference field was entered, the ledger comment defaults to the check number and the name of the payee.

The remarks in the reference field are the most critical item for tracing back transactions through the general ledger. With hundreds of checks being printed during a given month, the check number becomes the most important cross reference key. Thus the check number is included in the reference field of all the parts of the transaction.

Both CHECKWRT and ORDERENT are examples of how commercial software can be modified to specific tasks. The ORDERENT program enables a mail order firm to process not only their invoicing and accounts receivable with a single entry, but also to update their mailing lists with new customers using the original entry data. The CHECKWRT program bridges a gap in the SSG General Ledger system which made the system inconvenient to use for miscellaneous checks. By this specialization of commercially available programs, the consultant enables the end user to have the advantages of customized programs worth thousands of man hours of programming without having to pay for a total custom package.☐

Program Follows

PROGRAM LISTING

```
Rem  *******************************************
Rem  *                                         *
REM  *           CHECKWRITER PROGRAM           *
REM  *                   BY                    *
REM  *        ERIC D. SAVAGE                   *
REM  *                                         *
REM  *                                         *
REM  *                                         *
REM  *                                         *
REM  *               NOVEMBER 1978             *
REM  *           REVISION 3 JANUARY 1979       *
REM  *******************************************
rem
rem
rem-----------------Dimension Statements---------------
rem--Variables coincide with names in SSG General Ledger
rem
rem
DIM COA.DEPT.NO$(300), COA.ACCT.NO$(300)
DIM COA.ACCT.NAME$(300), acct.name$(20)
DIM MONTH$(12), lengthm(12)
DIM DORC$(20), ACCOUNT$(20), DEPT$(20), REMARKS$(20)
DIM LEDGER.COMMENT$(20)
DIM DCCODE$(6), AMOUNT(20),COMMENT$(20)
rem
rem
rem-------------Code for Normally Debit or Normally Credit--
rem
rem
DATA C,D,D,D,D,D
FOR I=0 TO 5
READ DCCODE$(I)
NEXT
rem
rem
rem This Program is written as a series of subroutines
rem which can be rearranged as desired to create the check format
REM THE FOLLOWING CONVENTIONS ARE USED
REM
REM    ESC 3 MEANS BACK UP ONE ENTRY
REM    ESC 7 MEANS STOP
REM    ESC 9 MEANS GOTO THE PARAMETER CHANGE SUBSYSTEM
REM           THESE ARE ONLY USED WHEN APPROPRIATE
Rem
rem
```

```
if end #2 then 100.4
       OPEN COA.FILE$ RECL 51 AS 2
PRINT "PARDON ME WHILE I READ IN THE GENERAL LEDGER ACCOUNTS"
i=0
100.96 I=I+1
       READ #2, I; dum$,  COA.DEPT.NO$(I),COA.ACCT.NO$(I),\
COA.ACCT.NAME$(I)
       No.of.accounts=no.of.accounts+1
       goto 100.96
100.4  CLOSE 2
       RETURN
200 REM
REM
REM----------------SMART DATE ENTRY ROUTINE----------------
REM
REM
DATA JANUARY, FEBRUARY, MARCH, APRIL, MAY, JUNE
DATA JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER
data 31,29,31,30,31,30,31,31,30,31,30,31
i=0
WHILE I LT 12
I=I+1
READ MONTH$(I)
WEND
i=0
while i lt 12
i=i+1
read lengthm(i)
wend
     gosub 900: rem Routine inputs the cash account number
Input "What is the Starting Check Number? ";check.number
check.number=check.number-1
233 INPUT "WHAT IS THE DATE? (MM/DD/YY) "; DATE$
REM THIS ROUTINE DECODES THE DATE
X=MATCH("/",DATE$,1)
MONTH=VAL(LEFT$(DATE$,X-1))
if month gt 12 or month lt 1 then goto 200.45
START=X+1
LENGTH=MATCH("/",DATE$,START)-START
DAY=VAL(MID$(DATE$,START,LENGTH))
if day lt 1 or day gt lengthm(month) then 200.45
YEAR=VAL("19"+RIGHT$(DATE$,2))
RETURN
200.45 Print "Invalid Date"
goto 233
300 REM
REM
REM------------MODULE LOOKS UP ACCOUNT NAMES GIVEN NUMBER---
REM----RETURNS UNKNOWN ACCOUNT FLAG IF ACCOUNT NUMBER---------
REM----ENDS IN A ZERO OR IS NOT FOUND IN THE ROUTINE---------
REM---------------REQUIRES IDENTICAL DEPARTMENT NUMBER--------
REM
REM
       Rem and Prints The Account Name on the Screen
flag=0
ic=0
if right$(account$(i),1)="0" then 310.998
while ic lt no.of.accounts
       ic=ic+1
if account$(i) ne coa.acct.no$(ic) then 310
if dept$(i)=coa.dept.no$(ic) then 200.2
```

```
rem
Rem     The General Ledger Data Disk Must be On Drive B
        gosub 100:  Rem This Section Opens The General Ledger Files
rem
rem
rem---------Sub 200 Inputs the Date, Starting Check Number---
rem
rem
        gosub 200
1000    gosub 400:  Rem This section Determines the Data for the Check
50.1 input "When Check is Ready Hit Return ";line q$
        gosub 600: Rem  This section prints the actual check
        gosub 500: Rem This section prints the accounting data on the stub
        gosub 750 :rem this section post the entry to the GL Batch
        goto 1000: Rem a return to the begining for another check
800     Rem This Section Finishes The project
        Close 1
        STOP
100 rem
rem
rem-------------File Opening Procedure--------------------
rem----------SSG Data Diskette Must be on Drive B---------
rem
rem
        X=SIZE("B:PGLPAR.101")
        IF X GT 0 THEN 100.1
        PRINT "E R R O R  GENERAL LEDGER DATA DISKETTE "
        PRINT "MUST BE ON DRIVE B"
        INPUT "INSERT PROPER DISKETTE AND RETURN";LINE Q$
        INITIALIZE: REM FOR CBASIC USE CALL 264
        GOTO 100
100.1   OPEN "B:PGLPAR.101" AS 1
        READ #1; PAR.CO.NO$,PAR.FILE.SUFFIX$,PAR.CO.NAME$
print tab(10); par.co.name$
        CLOSE 1: REM PARAMETER FILE NO LONGER NEEDED
REM
REM
REM------------BATCH FILE OPENING PROCEDURE----------------
REM---CHECK FOR EXISTENCE, OPEN OR CREATE AS APPROPRIATE---
REM
REM
BATCH.FILE$="B:PGLGJB"+PAR.FILE.SUFFIX$+".100"
        X=SIZE(BATCH.FILE$)
if end #1 then 100.3
        IF X GT 0 THEN 100.2
        PRINT\
"NO BATCH FILE EXISTS---ONE WILL BE CREATED"
        CREATE BATCH.FILE$ RECL 116 AS 1
GOTO 100.22
100.2   OPEN BATCH.FILE$ RECL 116 AS 1
100.22          READ #1; LINE DUMMY$
        rec.no=rec.no+1
        goto 100.22
REM
REM
REM-----------OPEN CHART OF ACCOUNT FILE--------------------
REM ------READ CHART OF ACCOUNTS INTO MEMORY ----------------
REM
REM
100.3 COA.FILE$="B:PGLCOA"+PAR.FILE.SUFFIX$+".101"
```

```
310 wend
310.998 print "Account Number Does Not Exist"
flag=1
return
200.2 print coa.acct.name$(ic)
acct.name$(i)=coa.acct.name$(ic)
return
400 REM
REM
REM----------CHECK DATA INPUT SECTION-----------------------
REM----------OPTIONS FOR STOPPING AND TRANSFER TO------------
REM--------PARAMETER CHANGE SUBSYSTEM ARE INCLUDED--------
REM
REM
INPUT "WHAT IS THE NAME OF THE PAYEE? "; LINE DUMMIT$
IF DUMMIT$=""OR DUMMIT$=CHR$(27)+"7"  THEN 800
if dummit$=chr$(27)+"9" then 2000
payee$=dummit$
Input "Address Line 1 "; line address1$
input "Address Line 2 ";line address2$
input "Address Line 3 "; line address3$
        check.amount=0
i=0
400.1 REM
REM
REM-----------MODULE READS IN ACCOUNTS COMMENTS AND AMOUNTS----
REM
REM
        INPUT "ENTER ACCOUNT NUMBER "; LINE ACCOUNT.NO$
IF ACCOUNT.NO$="" THEN 400.2
IF ACCOUNT.NO$=CHR$(27)+"7" THEN 400
if account.no$=Chr$(27)+"3" then print\
"PREVIOUS ENTRY DELETED RE-ENTER ACCOUNT NUMBER"
IF ACCOUNT.NO$=CHR$(27)+"3" THEN I=I-1
IF ACCOUNT.NO$=CHR$(27)+"3" THEN 400.1
IF LEN(ACCOUNT.NO$)=4 THEN ACCOUNT.NO$=ACCOUNT.NO$+"00"
I=I+1
DEPT$(I)=RIGHT$(ACCOUNT.NO$,2)
ACCOUNT$(I)=LEFT$(ACCOUNT.NO$,4)
gosub 300
if flag=1 then i=i-1
if flag=1 then 400.1
INPUT "ENTER REMARKS (FOR CHECK) "; LINE REMARKS$(I)
if remarks$(i)="" then print "Account Name Used for Remarks"
if Remarks$(i)="" then Remarks$(i)=acct.name$(i)
INPUT "ENTER REMARKS (FOR GENERAL LEDGER)"; LINE LEDGER$
LEDGER.COMMENT$(I)=LEDGER$
IF LEDGER$="" THEN LEDGER.COMMENT$(I)=REMARKS$(I)
if ledger$="" and remarks$(i)=acct.name$(i) then\
ledger.comment$(i)=payee$
ledger.comment$(i)=str$(check.number+1)+" "+ledger.comment$(i)
ledger.comment$(i)=ledger.comment$(i)+"                              "
ledger.comment$(i)=left$(ledger.comment$(i),30)
INPUT "ENTER AMOUNT "; AMOUNT(I)
INPUT "ENTER - OR RETURN"; LINE FLAG$
DORC$(I)=DCCODE$(VAL(LEFT$(ACCOUNT.NO$,1)))
IF FLAG$="" THEN 400.1
IF DORC$(I)="D" THEN DORC$(I)="C" ELSE DORC$(I)="D"
GOTO 400.1
400.2 REM
```

```
227: REM
228: REM--------DISPLAY OF CHECK DATA FOR FINAL REVIEW---------
229: REM
230: REM
231: PRINT "THIS IS A REVIEW OF THE CHECK PRIOR TO POSTING"
232: PRINT  "OR PRINTING"
233: PRINT
234: PRINT PAYEE$; tab(60); check.number+1
235: FOR K=1 TO I
236: IF DORC$(K)="D" THEN CHECK.AMOUNT=CHECK.AMOUNT+AMOUNT(K)
237: IF DORC$(K)="C" THEN CHECK.AMOUNT=CHECK.AMOUNT-AMOUNT(K)
238: PRINT ACCOUNT$(K)+DEPT$(K)+" "; TAB(20); REMARKS$(K)+" "; TAB(50);
239: if dorc$(k)="D" then print amount(k)
240: if dorc$(k)="C" then print -amount(k)
241: NEXT K
242: PRINT "          NET AMOUNT "; CHECK.AMOUNT
243: If Check.Amount lt 0 then print\
244: "NEGATIVE NET CHECK AMOUNT CHECK NOT ACCEPTABLE"
245: IF CHECK.AMOUNT LT 0 THEN 400
246: 400.3 INPUT "IS THIS CORRECT? "; Q$
247: IF LEFT$(Q$,1)="n" OR LEFT$(Q$,1)="N" THEN 400
248: IF LEFT$(Q$,1)="y" OR LEFT$(Q$,1)="Y" THEN RETURN
249: GOTO 400.3
250: 500 REM
251: REM
252: REM---------MODULE PRINTS OUT THE CHECK STUB----------
253: REM
254: REM
255: lprinter
256: check.number=check.number+1
257: print tab(15);payee$;
258: print tab(55);check.number;tab(65);month$(month);\
259:        " ";str$(day);", ";str$(year)
260: check.number=check.number-1
261:        print
262:        print
263:        print
264: Rem Item Printing
265: item$="/                            /    / /$####.##"
266: sin$="                                     --------"
267: dou$="                                     ========"
268: net$="     NET AMOUNT OF CHECK             $####.##"
269: SIGN$=" "
270* 500.1 For k=1 to i
271:        xamount=amount(k)
272:        if dorc$(k)="C" then xamount=-xamount
273:        print using item$;tab(10); remarks$(k),sign$,xamount
274:        sign$=" "
275:        next k
276: print tab(10);sin$
277:        print using net$;tab(10); check.amount
278: print tab(10);dou$
279: REM
280: REM
281: REM-----------SPECIAL ROUTINE FOR DIABLO 1640 PRINTERS-------
282: REM--------FOR OTHER PRINTERS SET PAGE LENGTH CONTROL-----------
283: REM---------FOR LENGTH OF CHECK AND DELETE THESE LINES----------
284: REM
285: REM
286: REM    THIS SECTION ADVANCES THE PRINTER TO THE NEXT CHECK
```

```
348: REM-------------SPACE DOWN TO STUB-----------------------
349: REM
350: REM
351: for space=1 to 7
352: print
353: next space
354: console
355: return
356: REM
357: REM
358: REM-----------NUMBER PRINTOUT ROUTINE----------------------
359: REM
360: REM
361: 700 if c1=0 then return
362: if c1=1 then print "ONE ";
363: IF C1=2 THEN PRINT "TWO ";
364: IF C1=3 THEN PRINT "THREE ";
365: IF C1=4 THEN PRINT "FOUR ";
366: IF C1=5 THEN PRINT "FIVE ";
367: IF C1=6 THEN PRINT "SIX ";
368: IF C1=7 THEN PRINT "SEVEN  ";
369: IF C1=8 THEN PRINT "EIGHT ";
370: IF C1=9 THEN PRINT "NINE ";
371: IF C1=10 THEN PRINT "TEN ";
372: IF C1=11 THEN PRINT "ELEVEN ";
373: IF C1=12 THEN PRINT "TWELVE ";
374: IF C1=13 THEN PRINT "THIRTEEN ";
375: IF C1=14 THEN PRINT "FOURTEEN ";
376: IF C1=15 THEN PRINT "FIFTEEN ";
377: IF C1=16 THEN PRINT "SIXTEEN ";
378: IF C1=17 THEN PRINT "SEVENTEEN ";
379: IF C1=18 THEN PRINT "EIGHTEEN ";
380: IF C1=19 THEN PRINT "NINETEEN ";
381: IF C1=20 THEN PRINT "TWENTY ";
382: IF C1=30 THEN PRINT "THIRTY ";
383: IF C1=40 THEN PRINT "FORTY ";
384: IF C1=50 THEN PRINT "FIFTY ";
385: IF C1=60 THEN PRINT "SIXTY ";
386: IF C1=70 THEN PRINT "SEVENTY ";
387: IF C1=80 THEN PRINT "EIGHTY ";
388: IF C1=90 THEN PRINT "NINETY ";
389: IF C1=100 THEN PRINT "HUNDRED ";
390: IF C1=1000 THEN PRINT "THOUSAND ";
391: RETURN
392: 750 REM
393: REM
394: REM------------POST TO THE JOURNAL BATCH---------------------
395: REM
396: REM
397: check.number=check.number+1
398* 750.1 for k=1 to i
399: print #1; " ", dept$(k),account$(k),acct.name$(k), date$,\
400:        amount(k),dorc$(k), ledger.comment$(k),0
401: next k
402: xcomment$=Str$(check.number)+" "+Payee$+"                   "
403: xcomment$=left$(xcomment$,30)
404: Print #1; " ",cash.dept$,cash.account$,cash.acct.name$,\
405:        date$,check.amount,"C",xcomment$,0
406: return
407: REM
```

```
REM    THE CHR$(42) IS THE LENGTH OF THE PAGE
REM    THIS SHOULD BE SET TO THE LENGTH OF THE CHECK
REM    BY SETTING THE 42 TO THE LENGTH OF THE CHECK MULTIPLIED BY
REM    6 THE SECOND LINE RESTORES THE PAGE LENGTH TO 66
REM    AFTER EACH CHECK IS PRINTED.
PRINT CHR$(27);CHR$(12);CHR$(42);CHR$(12)
PRINT CHR$(27);CHR$(12);CHR$(66)
Console
RETURN
600 REM
REM
REM---------------CHECK WRITING MODULE------------------------
REM-----------DESIGNED FOR MOORE BUSINESS FORM CHECKS---------
REM-----------------NUMBER          ---------------------------
REM
REM
x=check.amount
lprinter
check.number=check.number+1
print tab(55);check.number;tab(67);month$(month);\
        " ";str$(day);", ";str$(year)
check.number=check.number-1
print:print:print
print tab(3);"****";
cent$="DOLLARS AND ## CENTS"
REM
REM
REM---------------ALPHA DECODE FOR UP TO $20000---------------
REM
REM
If x lt 1000 then go to 111
c1=int(x/1000)
gosub 700
x=check.amount-1000*c1
c1=1000:gosub 700
111 if x lt 100 then goto 10.11
c1=int(x/100)
go sub 700
x=x-100*c1
c1=100:gosub 700
10.11 if x lt 20 then goto 10.19
c1=10*int(x/10):gosub 700
x=x-c1
10.19 c1=int(x)
gosub 700
x=x-c1
x=int(x*100)
print using cent$;x;
REM
REM
REM------------------COMPLETE CHECK------------------
REM
REM
print using "**####.##";tab(72);check.amount
print:print
print tab(14);payee$
print tab(14); address1$
print tab(14); address2$
print tab(14); address3$
REM
REM
```

```
REM
REM-----------------SET CASH ACCOUNT NUMBER--------------------
REM
REM
900 Input "What is the Cash Account Number? ";cash.account$
if len(cash.account$)=4 then cash.account$=cash.account$+"00"
cash.dept$=right$(cash.account$,2)
cash.account$=left$(cash.account$,4)
i=1
account$(i)=cash.account$
dept$(i)=cash.dept$
gosub 300 REM VERIFIES CASH ACCOUNT NUMBER
cash.acct.name$=acct.name$(1)
if flag=1 then 900
return
2000 REM
REM
REM--------PARAMETER CHANGE SUBSYSTEM------------------------
REM
REM
FOR IOTA=1 TO 24
PRINT
NEXT IOTA
PRINT\
"                THIS IS THE SPECIAL ACTION MODULE"
PRINT:PRINT\
"The Following Operations Can Be Performed:"
print:print\
"          Return to Main Program------- 1"
print\
"          Reset Check Numbering-------- 2"
print\
"          Reprint Check---------------- 3"
print\
"          Reset Date------------------- 4"
print\
"          Reset Cash Account----------  5"
Input "Indicate The Choice Desired-- :"; choice
if choice=1 then 400
2001.12 if choice ne 2 then 2001
Input "What is the Check Number? "; check.number
check.number=check.number-1
goto 2000
2001 if choice ne 3 then 2001.23
Input "When Check is Ready Hit Return";line q$
gosub 600
gosub 500
goto 2000
2001.23 if choice ne 4 then 2002
gosub 233
goto 2000
2002 if choice = 5 then gosub 900
goto 2000
END
NO ERRORS DETECTED
CONSTANT AREA:        8
CODE SIZE:         4903
DATA STMT AREA:     152
VARIABLE AREA:      480
A>
```

SABR STATISTICAL ANALYSIS FOR BUSINESS RESEARCH

An Integrated Statistics Package for Use on Small Computers

By John A. Lehman

Most of us have probably been exposed to statistics at some time in our careers. The more recently one has finished formal education, the more likely he or she is to have had statistics, since it is becoming a requirement in more and more disciplines. Unfortunately, doing statistical analysis by hand is not a very pleasant task. Calculators have made it much easier, but having to punch the same set of several hundred numbers into a calculator each time one wants to run a test or description is still not the way most of us would choose to pass our time. Since the main purpose for having a computer is to get *it* to take over the tedious tasks, statistical analysis seems like a prime candidate for computerization.

This is nothing new; IBM was releasing sets of statistical routines almost 20 years ago. However, all early programs have a major disadvantage; to run a particular program one must enter all data for that program. But to try a different test, *all* data must be reentered.

This article presents a small statistical package which can be run on a medium sized home computer system. The package allows room for expansion and customization, and does not require huge chunks of memory. The package name is SABR (Statistical Analysis for Business Research). The name reflects the author's interest (Business Administration) — it is not meant to indicate that the package cannot be used for non-business statistical work.

SYSTEM CONFIGURATION

The software has been written and run on a Z-80 system using TDL 8K BASIC and TDL's ZAPPLE monitor. There should be a minimum of 16K memory, including the memory which BASIC uses, but not including that which the monitor uses. Data is saved on cassette (although a disk could probably be used) and there are no particular terminal devices required by the software. I have used both a Teletype Model 33 and a video display board for the console. The only routines which may have to be changed by users of other systems are the tape loading and saving routines, described in the software section.

GENERAL STRUCTURE OF SABR

The overall structure of SABR is illustrated in Figure 1. Because it's for a small system, all of the useful routines are not placed into memory at one time. The package is written in sections, each of which is no larger than about 6K. Each section contains related routines, and all of the sections operate on a common datafile.

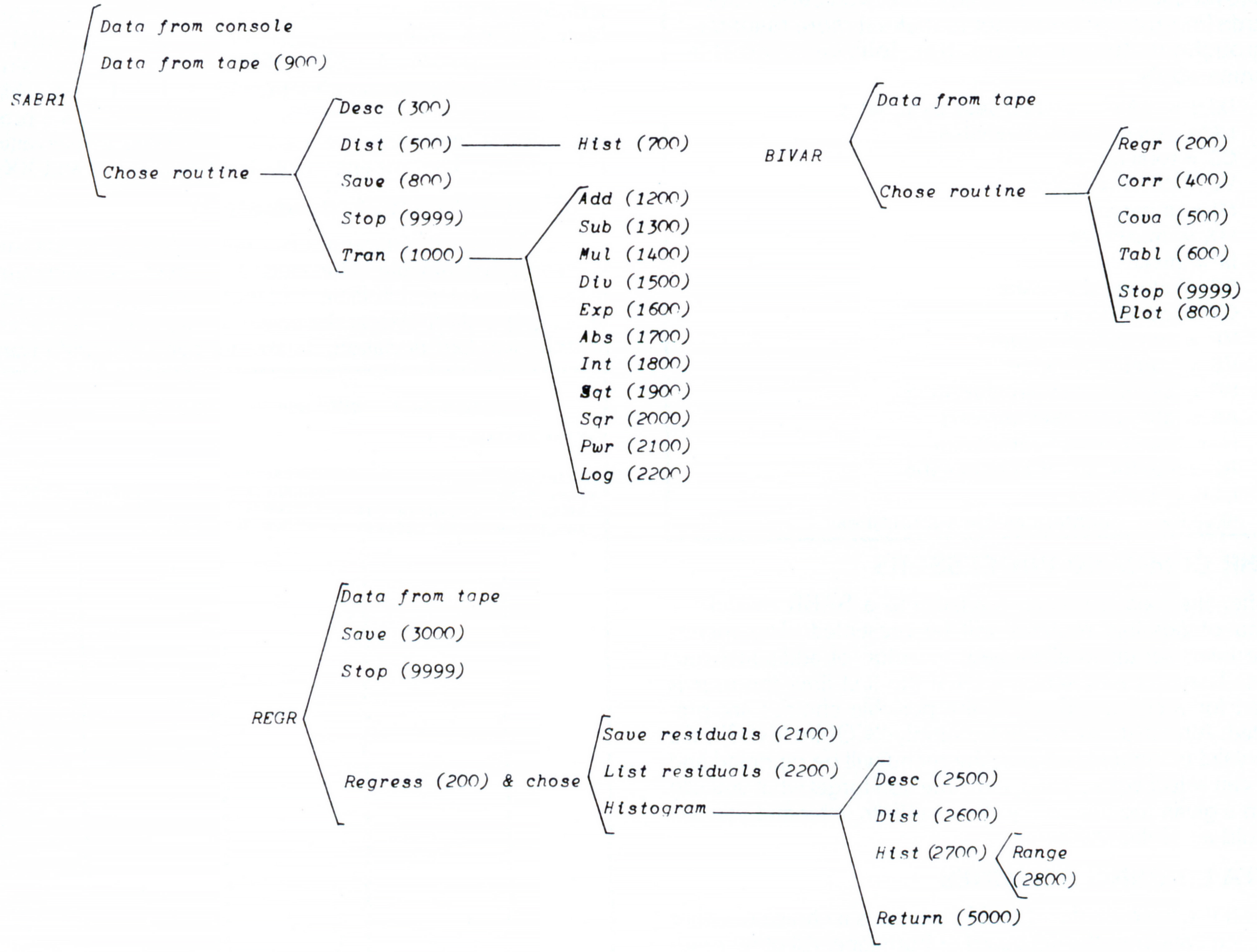

SABR1
Data from console
Data from tape (900)
Chose routine
Desc (300)
Dist (500)
Hist (700)
Save (800)
Stop (9999)
Tran (1000)
Add (1200)
Sub (1300)
Mul (1400)
Div (1500)
Exp (1600)
Abs (1700)
Int (1800)
Sqt (1900)
Sqr (2000)
Pwr (2100)
Log (2200)
BIVAR
Data from tape
Chose routine
Regr (200)
Corr (400)
Cova (500)
Tabl (600)
Stop (9999)
Plot (800)
REGR
Data from tape
Save (3000)
Stop (9999)
Regress (200) & chose
Save residuals (2100)
List residuals (2200)
Histogram
Desc (2500)
Dist (2600)
Hist (2700)
Range (2800)
Return (5000)

Figure 1. Structure of SABR.

The datafile is "rectangular"; it consists of a given number of columns and rows. Each column represents a different variable; each row represents a different observation. The user can select the configuration of columns and rows which he/she wants to use; any combination is OK as long as it will fit into the available memory. The configuration of the datafile is stored along with the file itself on tape. Labels for both the datafile itself and for all of the variables within it are also stored on the tape. Thus, the user does not have to remember how the datafile has been configured each time it is read in.

As mentioned, there are a number of different sections or modules. The first of the modules is used to set up the datafile and to get simple descriptive statistics about it. It includes the initialization routines, the univariate statistical routines, and transformation routines. The last enables a user to create new variables by mathematical transformations of existing ones. Finally, there are routines to save the datafile on tape. This module is probably the most useful. The second module reads in an existing datafile and allows the user to perform various bivariate descriptions and tests on the data. This module does not contain routines for modifying the data.

Most users will want to use these two modules, and there are others. In my own case, these are routines used in multivariate analysis. One routines tends to take an entire module when one is doing multiple regression or something of that nature. Other modules include one to perform special tests on survey data (such as descriptive statistics for stratified and cluster samples), and timeseries/econometric forecasting routines.

For that matter, most statistical programs can be adapted to SABR by coding them to use the SABR data structure and following some of the more important coding conventions. The detailed structure of the datafile is illustrated in Figure 2. Some of the coding conventions are illustrated in Table 1. These last are obviously not necessary if one writes separate modules, but they should at least help make the code somewhat more readable.

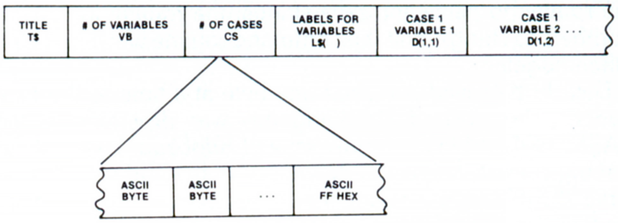

TITLE
T$
# OF VARIABLES
VB
# OF CASES
CS
LABELS FOR
VARIABLES
L$( )
CASE 1
VARIABLE 1
D(1,1)
CASE 1
VARIABLE 2 . . .
D(1,2)
ASCII
BYTE
ASCII
BYTE
. . .
ASCII
FF HEX

Figure 2. SABR File Structure.

Table 1. Notes on SABR Code

SABR is a fairly long package, as BASIC programs go (over 800 statements). I have followed certain standards (more or less) in order to make it more readable. Throughout the program, the following variable names apply.

D(i,j) = SABR datafile, case by variable
L$ = labels for each variable
CS = total cases
VB = total variables
MI = minimum
MX = maximum
M = mean
SD = standard deviation
CV = covariance
VP = population variance
VS = sample variance
SP = sample standard deviation
A$ = string for user answers
R = coefficient of correlation
R2 = coefficient of determination
I,J,K = counters
I9,J9,K9 = counters within subroutines

SABR COMMAND PROCESSORS

After the data has been loaded into a SABR module, a menu of possible routines will be presented. The menus have been set up to allow easy insertion of additional routines. They are also set up so that the first time the user is asked for a command, all of the possible choices are presented. After that, the prompt is simply "COMMAND?". If a non-valid command is typed, the menu will be reprinted and you can select again. Thus, any time you forget what you can do in a given module, just enter a random letter and you will be told all of the choices.

DATA LOADING ROUTINES

With the main module (SABR1) there is a choice of either entering data from the keyboard or from tape. All other modules load data from tape only. There are three basic parts to a tape load. The first is the string load routine which loads a string from the tape byte by byte. The second is the number loading routine which itself calls the above string routine, and then converts the result to a number. The third part is the main routine which calls the others in the proper order and which assigns their results to the proper variables.

Since BASIC subroutines cannot pass parameters like FORTRAN or PL/1, the solution used here has been to have the subroutine return a string in X$ and a number in XX. The calling routine then sets these equal to the proper variable. Thus, to read A$ from the tape, GOSUB to the string read routine and then LET A$=X$.

DATA SAVE ON TAPE

This routine is used in the main module (SABR1) and in the multiple regression routine. It will also be needed if the TRANsformation routines are separated from the main module in order to save memory space. Like the load routine, the save routine is divided into three sections. These are the routine to parse and save strings, the routine to convert numbers to strings, and the command routine which puts the others together.

Data to be saved is output one byte at a time to the tape punch. The method for doing this was described in the BASIC FORUM in the fourth issue of *Kilobaud.* Each byte in a string is extracted, converted to a number and stored in an array (SS(I9) in my code). Each number in the array, including the end of string mark (FFH, 255 decimal) is then output to the tape punch.

One way this can be done is to assign the list device to the tape punch. In the TDL system this is done by patching the user list vector (F815-17) to the tape output routine in the monitor (F4CE). BASIC WAIT and OUT statements could be used, but this would require setting up the 6850 I/O interface, and the monitor already has the software to do this. Note also the routine at the end of line 860 in SABR1 to waste time (for k9=1to99:nextk9). This is necessary since the BASIC interpreter won't input data at 1200 baud, which is the speed of the cassette driver. If the slow I/O is a problem, reduce the number of loops; 99 is fairly conservative. Like the tape load routines, data is passed in X$ and XX.

SUBROUTINE DESC (Example 1)

The DESC subroutine prints a set of descriptive statistics for a selected variable. The statistics printed are: minimum, maximum, mean, coefficient of variation, population variance, population standard deviation, sample variance and sample standard deviation. These are fairly straightforward.

Example 1 DESC and WRIT from SABR1

```
WHICH VARIABLE? 1

MINIMUM= 1                       MAXIMUM= 4
MEAN= 2.08                       COEFFICIENT OF VARIATION= .437121
POPULATION VARIANCE= .7936       POPULATION SD= .890842
SAMPLE VARIANCE= .826667         SAMPLE SD= .909212

        1          1          1          1
        1          1          2          1
        1          1          3          1
        1          2          4          1
        2          2          5          1
        2          2          6          1
        2          3          7          1
        2          3          8          1
        3          3          9          1
        3          4          10         1
        3          4          11         1
        3          4          12         1
        1          1          1          2
        1          1          2          2
        1          1          3          2
        1          2          4          2
        2          2          5          2
        2          2          6          2
        2          3          7          2
        2          3          8          2
        3          3          9          2
        3          4          10         2
        3          4          11         2
        3          4          12         2
        4          4          1          3
```

The coefficient of variation is the sample standard deviation divided by the mean. Population variance and standard deviation have N degrees of freedom; sample statistics have N-1 degrees of freedom (i.e. the denominator is either N or N-1). If you prefer your coefficient of variation to reflect population rather than sample values, change CV=SD/N to CV=SP/N in line 370.

SUBROUTINE DIST (Example 2)

Example 2 DIST and HIST from SABR1

```
VARIABLE   NAME
 1           A
 2           B
 3           C
 4           D

WHICH VARIABLE#? 3
HOW MANY FREQ CLASSES? 3
UPPER BOUND FOR CLASS
 1 ? 4
 2 ? 10
 3 ? 15
CHANGES,YES OR NO? NO
  **FREQ. DISTRIBUTION**

UPPER BOUND     COUNT      PROPORTION

 4              7              .28
 10             12             .48
 15             6              .24
STOP,HIST OR MORE? HIST
 **HISTOGRAM**
UPPER BOUND

 4   +*******
 10  +************
 15  +******
```

The DIST subroutine prints a frequency distribution and an optional histogram (bargraph) of a selected variable. You select how many classes are wanted and what should be their boundaries each time the routine is run. Note that the upper bounds are *not* inclusive — an interval with a lower bound of zero and an upper bound of one does not include one (but does include zero). Note also that if any frequency class contains more than about 400 points, the histogram routine will blow up.

SUBROUTINE TRAN

The TRAN subroutine allows the transformation of variables using most of the math functions built into BASIC. I have not included the trig functions, but they should be easy to add if necessary. The available transformations are: addition, subtraction, multiplication, division, exponentiation, absolute value, integer value, log, power, (both exponentiation and log are base e; power is base 10), square root and square. You can specify which variable you want to transform and where you want to put the result.The result can be either an existing or a new variable.

With addition, subtraction, multiplication and division, either a constant or another variable can be used as the second term. Thus, if v1 were a price index for C periods and v2 were an economic series, the second could be divided by the first to get a deflated value. The subroutine is *partly* idiotproof (it won't allow division by zero or take the square root of a negative number) — when you do something fatal like this it tells where the mistake is and replaces the missing value with zero.

TRAN is shown included in the main program (SABR1). However, putting the two together uses up quite a bit of memory. I tend to use TRAN as a separate program and leave it out of SABR1 if the datafiles I am analyzing are at all large. Once the combination is up and running, it is a simple matter to delete the unnecessary statements for each program (SABR1 and TRAN) and save both parts as well as the whole.

SIMPLE REGRESSION ROUTINE (Example 3)

This is the first routine on the Bivariate menu. Regression is fitting a straight line to describe the relationship of two variables. The independent variable changes and then this produces changes in the dependent variable. We might find, for example, that the amount of memory in a small computer system is a function of the amount of money sunk into the system. An equation might be Y=1+.005X where Y is the amount of memory (in one K chunks) and X is the amount of money spent.

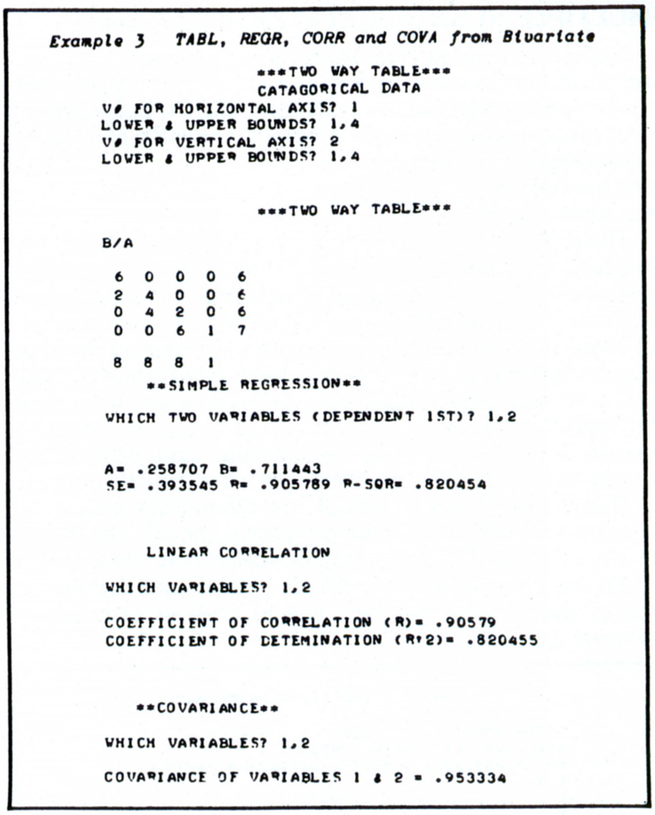
Simple regression allows the calculation of the equation of a line like the above, given a series of observations on Y and X. It uses what is known as "least squares", meaning it minimizes the sum of the squares of the errors. The standard error of the regression tells how far the estimate is likely to be off, while the R-squared tells how much variation you have explained. If the r^2 for the above regression were .75, this would mean that 75% of the variation in amount of memory was due to the amount of money invested.

CORRELATION ROUTINE (Example 3)

Correlation is like regression, except that it does not assume that one thing causes another. The routine here gives the correlation between one variable and another, i.e. how much of the changes in the two are interrelated. The interpretation is similar to that of r^2 for simple regression. Like regression, the correlation routine assumes that any relationship is linear.

TWO WAY TABLE (Example 3)

The TABL routine builds a matrix showing which elements have a given value of one variable *and* a given value of a second. This might be used, for example, to see how many people in a club have systems with both 16-24K of memory and two high level languages. The subroutine also computes marginal values. This means that it prints the sums of all of the rows on the right hand side, and the sums of the columns at the bottom. Users should be advised that the program as written has quite a few loops and takes a long time to execute.



Example 3 TABL, REGR, CORR and COVA from Bivariate

```
                    ***TWO WAY TABLE***
                    CATAGORICAL DATA
V# FOR HORIZONTAL AXIS? 1
LOWER & UPPER BOUNDS? 1,4
V# FOR VERTICAL AXIS? 2
LOWER & UPPER BOUNDS? 1,4


                    ***TWO WAY TABLE***

B/A

 6  0  0  0  6
 2  4  0  0  6
 0  4  2  0  6
 0  0  6  1  7

 8  8  8  1
    **SIMPLE REGRESSION**

WHICH TWO VARIABLES (DEPENDENT 1ST)? 1,2


A= .258707 B= .711443
SE= .393545 R= .905789 R-SQR= .820454



    LINEAR CORRELATION

WHICH VARIABLES? 1,2

COEFFICIENT OF CORRELATION (R)= .90579
COEFFICIENT OF DETEMINATION (R↑2)= .820455



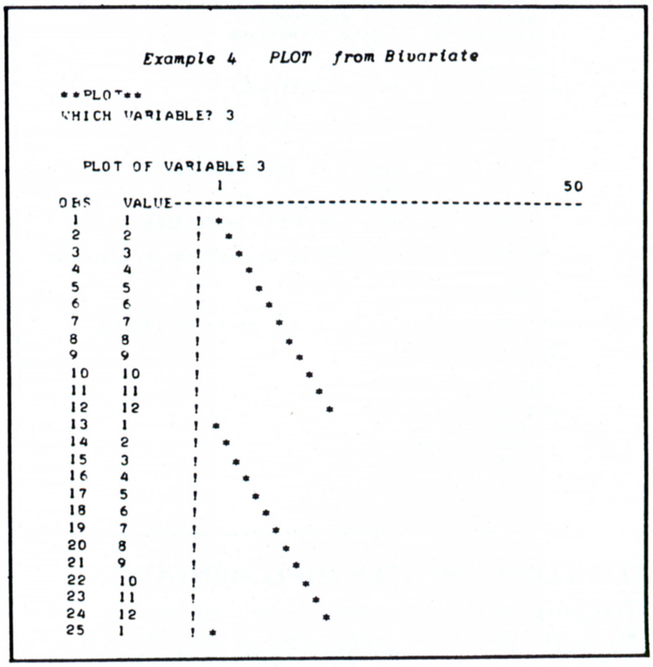
   **COVARIANCE**

WHICH VARIABLES? 1,2

COVARIANCE OF VARIABLES 1 & 2 = .953334
```

COVARIANCE ROUTINE (Example 3)

This routine calculates the covariance between two variables. This is a measure of the degree to which the two vary together.



Example 4 PLOT from Bivariate

```
**PLOT**
WHICH VARIABLE? 3


  PLOT OF VARIABLE 3
                    1                                        50
OBS    VALUE------------------------------------------------------
 1      1         ! *
 2      2         !  *
 3      3         !   *
 4      4         !    *
 5      5         !     *
 6      6         !      *
 7      7         !       *
 8      8         !        *
 9      9         !         *
 10     10        !          *
 11     11        !           *
 12     12        !            *
 13     1         ! *
 14     2         !  *
 15     3         !   *
 16     4         !    *
 17     5         !     *
 18     6         !      *
 19     7         !       *
 20     8         !        *
 21     9         !         *
 22     10        !          *
 23     11        !           *
 24     12        !            *
 25     1         ! *
```

PLOT ROUTINE (Example 4)

This routine, while contained in the bivariate package, is bivariate only if one considers time to be one of the variables. It simply plots the values of a given variable for each case in the datafile. The routine automatically scales the data so that the plot will not overflow the page.

MULTIPLE REGRESSION PROGRAM (Example 5)

Multiple regression is similar to simple regression (as contained in the Bivariate package). The multiple variety uses more than one variable to explain the variation in the dependent variable. The regression program in SABR will calculate the regression equation, the standard error of the regression and the coefficients of correlation (r) and determination (r^2) in the same way as the simple regression package.

The multiple version also permits saving and analyzing the residuals from each regression. The residuals are the difference between what the equation describes the data as and what they really are. They are what the least squares method of regression minimizes. The reason for analyzing the residuals is that this gives you quite a lot of information on how well your regression model really fits the data, and what must be done to improve the fit. With this program you can do a certain amount of analysis on the spot, and/or save the results to analyze in more detail with other SABR routines.

This package gives an idea of how other programs can be adapted to SABR. Part of the program is modified from one in *Common BASIC Programs.* Modified here means both that it was changed to fit the SABR structure and that the error in the original program which made it give wrong answers was corrected.

Example 5 Multiple regression

```
**MULTIPLE REGRESSION**
HOW MANY INDEPENDENT VARIABLE? 3
ENTER VARIABLE NUMBERS, DEPENDENT FIRST
? 1
? 2
? 3
? 4
            EQUATION COEFFICIENTS

            CONSTANT= .0935592
            V( 2 ) (B)= .786958
            V( 3 ) (C)=-.032562
            V( 4 ) (D)= .113025

            R-SQUARED= .83624
                     R= .914462
            STD ERROR OF ESTIMATE= .393337
DO YOU WANT TO:
    SAVE-SAVE RESIDUALS IN THE DATABASE
    LIST-LIST RESIDUALS
    HIST-HISTOGRAM OF RESIDUALS
    RETN-RETURN TO MAIN REGRESSION ROUTINE
? SAVE
  SAVING RESIDUALS
LABEL FOR NEW VARIABLE? RESIDUAL

RESIDUALS SAVED AS V( 5 ) RESIDUAL

DO YOU WANT TO:
    SAVE-SAVE RESIDUALS IN THE DATABASE
    LIST-LIST RESIDUALS
    HIST-HISTOGRAM OF RESIDUALS
    RETN-RETURN TO MAIN REGRESSION ROUTINE
? HIST
  HISTOGRAM AND DESCRIPTIVE STATISTICS OF RESIDUAL

    HISTOGRAM

MINIMUM=-.763276                    MAXIMUM= .725601
MEAN=-1.04904E-07
UPPER BOUND

-.51513 +**
-.266984 +****
-.0188375 +******
 .229309 +******
 .477455 +*****
 .725601 +*
```

NOTES ON COMPUTER IMPLEMENTATION

The SABR package has been written and run on a TDL Z-80 based system (the predecessor of the present XITAN system). It is written in TDL 8K BASIC which is very similar to Altair BASIC. The package requires a minimum of one cassette recorder and 16K of user memory. This latter includes the space taken by BASIC, but does not include the space taken by the system monitor.

One of the major features of SABR is that it saves and loads datafiles on cassette tapes. TDL BASIC does not have the facility to do this directly, but it does have the ability to write on a list device other than the console, and to run in batch mode (input from logical reader, output to list device). SABR assumes that the logical list device has been set up as the cassette punch in the operating system before BASIC is run. Files are read by changing over to batch mode from the middle of a program. SWITCH 2 changes to batch mode, and SWITCH 3 changes back to the user console. Timing loops on write are required. It is rather slow and cumbersome, but it gets the job done.

Users of other BASICs have a number of choices when they go to implement this filesave facility. BASICs which include SWITCH, LPRINT and allow running in batch can be used with the above kluge. If a BASIC allows direct saving of files on tape or disk, one will have to rewrite the save and load routines for the system. Those who have a version of Altair BASIC which does not include data saving, look at *Dr. Dobbs Journal of Computer Calisthenics and Orthodontia,* October, 1976. This is an article on saving data from Altair BASIC. Alternatively, *Kilobaud,* May, 1978, has an article which shows how to do this. Others may want to look at the BASIC Forum in *Kilobaud* numbers 2 and 4, which is the source of much of what I have done here.

The routines just described are fairly slow. This is due to the need to make sure that the tape does not outrun the program. If you have a controlled reader/punch, loading and saving data can be very much speeded up. For those with TDL's tape interface, it is written up in TDL's Technical Memorandum #106. The basic idea here is to load blocks of data into a buffer with the buffer being saved or loaded on tape.

To use the controlled reader/punch for saving data, the list device is configured to the tape punch. TDL users should assign List to F4C4 HEX and then assign reader and punch to the user defined controlled routines. The data can then be output to tape using LLIST and read in in batch using SWITCH. A listing of the modified routines for the TDL system is illustrated in Listing 4.

One important suggestion for using SABR is to save a file as soon as it has been created. This takes a great deal of time but is not the unnecessary bother it may seem at first. In fact, it becomes only common sense after the first time the local electric utility burps and wipes out BASIC, SABR and the few hundred datapoints which were just entered.☐

ABOUT THE AUTHOR

John A. Lehman, MA, MBA is a doctoral student in Business Administration at the University of Michigan. Financial officer of the Ann Arbor Computing club; involved with personal computers since 1975.

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Harnett, *Introduction to Statistical Methods,* Addison Wesley, 1975. Another standard text.

Nie, et al, *Statistical Package for the Social Sciences,* McGraw Hill, 1975. For those who want to see what a maxi-computer statistical package looks like.

Poole & Borchers, *Some Common BASIC Programs,* Osborne & Associates, 1977. A good collection of statistical programs which can be adapted to SABR. Note that statements 630-640 in the Multiple regression program (p. 148) should be omitted.

Scientific Research, *BASIC Software Library,* volume 2. Another good collection of BASIC statistical programs.

Salzman, *Computerized Economic Analysis,* McGraw Hill, 1968. This book is out of date (the programs are in FORTRAN II), but it is interesting since it involves a statistical package for an IBM 1401 with either 8 or 16K of core.

IBM's Scientific Subroutine Package (IBM form H20-0205) has quite a few good programs for those into translating between FORTRAN IV and BASIC.

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24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46
47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92
93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115
116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138
139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161
162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184
185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207

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B. ☐ Firmware
C. ☐ Software
D. ☐ Other

6. My Professional Interest is:
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B. ☐ Inventory Control System
C. ☐ Process Control System
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G. ☐ Other

7. My Personal Interest is:
A. ☐ Games
B. ☐ Home Economics
C. ☐ Computer Art and Graphics
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E. ☐ Child Educational Development
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G. ☐ Other

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24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46
47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92
93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115
116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138
139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161
162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184
185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207

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F. ☐ Consumer (Hobbyist, Etc.)
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D. ☐ Other

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C. ☐ Process Control System
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PROGRAM LISTING

LISTING 1

```
1 REM **SABR**  9/78 VERSION BY JOHN LEHMAN
2 REM THIS PROGRAM SETS UP A FILE
3 REM AND/OR PERFORMS STATISTICAL ANALYSIS.
7 REM THE FORMAT OF THE DB ON TAPE WILL BE T$ (LABEL),VB,CS,
8 REM L$(N) (INDIVIDUAL LABELS),V[1],V[2],ETC.
10 DIM D(25,4):REM D=DATABASE
11 DIMF9(25),SS(15),F8(25),B(25)
14 ?:?TAB(20)"*****SABR*****":?:?
15 INPUT"DO YOU WANT TO ENTER DATA 'HERE' OR FROM 'TAPE'";A$
16 IFA$="TAPE"THEN900
17 IFA$<>"HERE"THEN 15
20 INPUT"NAME OF DATABASE/FILE";T$
30 INPUT"STAT DB INITIALIZATION. ENTER # VARIABLES & # CASES";VB,CS
40 FOR I=1 TO VB:?"LABEL FOR VARIABLE";I:INPUT L$(I):NEXT I
45 FOR I=1 TO CS:FOR J=1 TO VB:?"ITEM";I;J;:INPUTD(I,J)
50 NEXT J:?:NEXT I
70 INPUT "ANY CHANGES,YES OR NO";N$
80 IF N$="NO" OR N$="NO" THEN 120
90 INPUT"ENTER VARIABLE AND CASE NUMBERS FOR CHANGE";V1,C1
100 INPUT "NEW VALUE";D(C1,V1)
110 GOTO 70
112 ?"**DATABASE INITIALIZED**"
120 ?"WOULD YOU LIKE TO:"
130 ?"  DESC-GET DESCRIPTIVE STATISTICS"
140 ?"  DIST-GET FREQUENCY DISTRIBUTIONS"
145 ?"  TRAN-PERFORM TRANSFORMATIONS ON VARIABLES"
150 ?"  SAVE-SAVE THE DATABASE ON TAPE"
160 ?"  STOP-END THE RUN"
165 ?"  WRIT-LIST THE DATABASE"
170 ?:?:?:INPUT "COMMAND"; A$
180 IF A$="DESC" THEN 230
190 IF A$="DIST" THEN 240
200 IF A$="SAVE" THEN 250
210 IF A$="STOP" THEN 270
215 IFA$="TRAN" THEN 280
217 IFA$="WRIT"THEN295
220 GOTO 120
230 GOSUB 300:REM DESC
235 GOTO 170
240 GOSUB 500:REM DIST
245 GOTO 170
250 GOSUB 800:REM SAVE
255 GOTO 170
270 GOTO 9999
275 GOTO 170
280 GOSUB 1000
290 GOTO 170
295 FORI=1TOCS:FORJ=1TOVB:?D(I,J),:NEXTJ:?:NEXTI:GOTO170
300 REM COMPUTES MIN,MAX,MEAN,SIGMA,SIGMA↑2,S,S↑2,CV
305 S1=0:S2=0
310 INPUT"WHICH VARIABLE";V
320 FOR I=1 TO CS
330 S1=S1+D(I,V)*D(I,V):S2=S2+D(I,V):NEXT I:REM SUMS SQUARES
340 M=S2/CS
350 VP=(S1-(S2*S2/CS))/CS:SP=SQR(VP):REM POPULATION SD
360 VS=(S1-(S2*S2/CS))/(CS-1):SD=SQR(VS)
370 CV=SD/M:REM CV
380 N=CS-1
390 MI=D(1,V):MX=D(1,V):REM MIN AND MAX
400 FOR I=1TON:IFMI<=D((I+1),V)THEN 410:ELSEMI=D((I+1),V)
410 IF MX>=D((I+1),V)THEN 420:ELSE MX=D((I+1),V)
420 NEXT I
430 ?:?"MINIMUM=";MI;TAB(35);"MAXIMUM=";MX
440 ?"MEAN=";M;TAB(35);"COEFFICIENT OF VARIATION=";CV
450 ?"POPULATION VARIANCE=";VP;TAB(35);"POPULATION SD=";SP
460 ?"SAMPLE VARIANCE=";VS;TAB(35);"SAMPLE SD=";SD
470 ?:?:RETURN
500 REM SUBROUTINE FOR FREQUENCY DISTRIBUTIONS
510 ?"VARIABLE   NAME":REM REMIND WHICH IS WHICH
520 FOR I=1 TOVB:?I,L$(I):NEXT:?
530 INPUT"WHICH VARIABLE#";V
535 FORI=1TO10:F9(I)=0:NEXTI
540 INPUT"HOW MANY FREQ CLASSES";N
550 ?"UPPER BOUND FOR CLASS":FOR I=1TON:?I;:INPUTB(I):NEXTI
560 INPUT"CHANGES,YES OR NO";A$:IFA$="NO"THEN580
570 INPUT"WHICH NUMBER";I:INPUT"VALUE";B(I):GOTO 560
580 FORI=1 TO CS:IF D(I,V)<B(1) THEN F9(1)=F9(1)+1
```

```
585 FOR J=2TON
590 IFNOT(D(I,V)<B(J))THEN 599
595 IF D(I,V)<B(J-1) THEN 599
597 F9(J)=F9(J)+1
599 NEXT J
600 NEXTI:?:?:?:?"  **FREQ. DISTRIBUTION**":?
610 ?"UPPER BOUND      COUNT      PROPORTION":?
620 FORI=1TON:F8(I)=F9(I)/CS:?B(I),F9(I),F8(I):NEXTI
630 ?:?:?:INPUT"STOP,HIST OR MORE";A$:IFA$="MORE"THEN530
640 IFA$="HIST"THEN GOSUB 700
650 RETURN
700 REM SUBROUTINE HIST
710 P$="*******************************************************"
720 ?:?:?"  **HISTOGRAM**":?:?
730 J=1:REM COUNT
740 FORI=1TON:IFF9(I)>50THENJ=2:IFF9(I)>100THENJ=3
755 IF F9(I)>150THENJ=4:IF F9(I)>200THENJ=5
757 IFF9(I)>250THENJ=6:IFF9(I)>300THENJ=7:NEXTI
760 ?"UPPER BOUND":?
770 FORI=1TON:N1=F9(I)/J:A$=LEFT$(P$,N1):?B(I);TAB(5)"+";A$:NEXTI
780 ?:?:?:RETURN
800 REM SUBROUTINE TO SAVE FILES ON TAPE.  FORMAT IS FILE-LABEL,
801 REM #V,#C,INDIVIDUAL LABELS,V1C1,V1C2,ETC.
810 ?:?"**STARTING SAVE**"
815 INPUT"START PUNCH & PRESS A KEY WHEN READY";A$
820 X$=T$:GOSUB850:XX=VB:GOSUB870:XX=CS:GOSUB870
825 FORI=1TOVB:X$=L$(I):GOSUB 850:NEXTI
830 FORI=1TOCS:FORJ=1TOVB:XX=D(I,J):GOSUB870:NEXTJ:NEXTI
835 ?"DATABASE SAVED":RETURN
850 REMSTRING SAVE SUBROUTINE,SAVE IN X$
855 FORI9=1TOLEN(X$):SS(I9)=ASC(MID$(X$,I9,1)):NEXTI9:SS(I9)=255
860 FORI9=1TOLEN(X$)+1:LPRINTSS(I9):FORK9=1TO99:NEXTK9:NEXTI9
865 RETURN
870 X$=STR$(XX):GOSUB850:RETURN:REM SEND IN XX
900 REM SUBROUTINE TO LOAD A FILE FROM TAPE
905 INPUT"START READER AND PRESS A KEY";A$:TRACE 1
910 GOSUB 950:T$=X$:GOSUB 970:VB=XX:GOSUB970:CS=XX
915 FORI=1TOVB:GOSUB950:L$(I)=X$:NEXTI
920 FORI=1TOCS:FORJ=1TOVB:GOSUB970:D(I,J)=XX:NEXTJ:NEXTI:TRACE 0
930 ?"LOADED":?:GOTO 112
950 I9=0:REMRETURN IN X$
955 I9=I9+1
960 SWITCH 2:INPUTSS(I9):SWITCH 3:IFSS(I9)<>255THEN 955
965 J9=I9-1:X$="":FORI9=1TOJ9:X$=X$+CHR$(SS(I9)):NEXTI9:RETURN
970 GOSUB950:XX=VAL(X$):RETURN:REM LOAD NUMBER
1000 REM SUBROUTINE TO PERFORM TRANSFORMATIONS
1010 ?"   ***TRANSFORMATION ROUTINE***"
1020 INPUT "WOULD YOU LIKE A LIST OF TRANSFORMATIONS";A$
1030 IF LEFT$(A$,1)="Y" THEN GOSUB 2500
1040 INPUT"DESTINATION AND SOURCE VARIABLE NUMBERS";V,V1
1050 INPUT"WHICH TRANSFORMATION";T$
1060 IF T$="ADD"THEN GOSUB 1200
1070 IF T$="SUB" THEN GOSUB 1300
1080 IF T$="MUL" THEN GOSUB 1400
1090 IF T$="DIV" THEN GOSUB 1500
1100 IF T$="EXP" THEN GOSUB 1600
1110 IF T$="ABS" THEN GOSUB 1700
1120 IF T$="INT" THEN GOSUB 1800
1130 IF T$="LOG" THEN GOSUB 2200
1140 IF T$="PWR" THEN GOSUB 2100
1595 RETURN
1600 ?"  EXPONENTIATION TRANSFORMATION"
1610 FOR I=1TOCS
1620 D(I,V)=EXP(D(I,V1))
1630 NEXT I
1640 RETURN
1700 ?"  ABSOLUTE VALUE TRANSFORMATION"
1710 FOR I=1TOCS
1720 D(I,V)=ABS(D(I,V1))
1730 NEXTI
1740 RETURN
1800 ?"  INTEGER TRANSFORMATION"
1810 FOR I=1TOCS
1820 D(I,V)=INT(D(I,V1))
1830 NEXT I
1840 RETURN
1900 ?"  SQUARE ROOT TRANSFORMATION"
1910 FOR I=1TOCS
1920 IF D(I,V1)>=0 THEN 1960
1930 ?"ATTEMPT TO TAKE SQUARE ROOT OF NEGATIVE NUMBER AT CASE ";I
1940 D(I,V)=0
1950 GOTO 1980
1960 D(I,V)=SQR(D(I,V1))
1980 NEXT I
1990 RETURN
2000 ?"  SQUARE TRANSFORMATION"
2010 FOR I=1TOCS
2020 D(I,V)=D(I,V1)*D(I,V1)
2030 NEXT I
2040 RETURN
2100 ?"  POWER TRANSFORMATION"
2110 INPUT"TO WHAT POWER";P
2120 FOR I=1TOCS
2130 D(I,V)=D(I,V1)↑P
2140 NEXT I
2150 RETURN
2200 ?"  LOG TRANSFORMATION"
2210 FOR I=1TOCS
2220 D(I,V)=LOG(D(I,V1))
2230 NEXT I
2240 RETURN
2500 REM SUBROUTINE TO PRINT ALTERATIVE TRANSFORMATIONS
2510 ?"TRANSFORMATIONS  AVAILABLE ARE:"
2520 ?"ADD,SUB,MUL,DIV,PWR"
2530 ?"SQR,SQT,LOG,EXP,ABS,INT"
2540 ?:RETURN
9999 END
```

LISTING 2

```
1 REM BIVARIATE  9/78 VERSION BY JOHN LEHMAN
2 DIM SS(15)
5 DIM D(50,8),T(10,10),A(10),B(10)
10 REM THIS PROGRAM PERFORMS BIVARIATE ANALYSIS ON STATISTICAL
20 REM DATA FROM A SABR FILE.  THE FILE INPUT FORMAT IS:
24 REM NAME OF DATABASE,#VARIABLES,#CASES,LABELS FOR EACH
26 REM VARIABLE, VARIABLE VALUES
28 ?"  **SABR BIVARIATE**":?
29 INPUT"START READER & PRESS A KEY";A$:TRACE 1
30 GOSUB40:T$=X$:GOSUB60:VB=XX:GOSUB60:CS=XX
```

```
1150 IF T$="SQR" THEN GOSUB 2000
1160 IF T$="SQT" THEN GOSUB 1900
1170 RETURN
1200 ?"  ADDITION TRANSFORMATION"
1210 INPUT"ADD VARIABLE ('V') OR CONSTANT ('C')";A$
1220 IF A$="V" THEN 1260
1230 INPUT"VALUE OF CONSTANT";P
1235 FOR I=1TOCS
1240 D(I,V)=D(I,V1)+P
1245 NEXT I
1250 RETURN
1260 INPUT"WHICH VARIABLE";V2
1265 FORI=1TOCS
1270 D(I,V)=D(I,V1)+D(I,V2)
1275 NEXT I
1280 RETURN
1300 ?"  SUBTRACT TRANSFORMATION"
1310 INPUT"SUBTRACT VARIABLE ('V') OR CONSTANT('C')";A$
1320 IF A$="V" THEN 1360
1330 INPUT "VALUE OF CONSTANT";P
1335 FOR I=1TOCS
1340 D(I,V)=D(I,V1)-P
1345 NEXT I
1350 RETURN
1360 INPUT"WHICH VARIABLE";V2
1365 FOR I=1TOCS
1370 D(I,V)=D(I,V1)-D(I,V2)
1380 NEXT I
1390 RETURN
1400 ?"  MULTIPLY TRANSFORMATION"
1410 INPUT"MULTIPLY BY VARIABLE ('V') OR CONSTANT ('C')";A$
1420 IF A$="V"THEN 1460
1430 INPUT "VALUE OF CONSTANT";P
1435 FOR I=1TOCS
1440 D(I,V)=D(I,V1)*P
1445 NEXT I
1450 RETURN
1460 INPUT"WHICH VARIABLE";V2
1465 FOR I=1TOCS
1470 D(I,V)=D(I,V1)*D(I,V2)
1475 NEXTI
1480 RETURN
1500 ?"  DIVIDE TRANSFORMATION"
1505 INPUT"DIVIDE BY CONSTANT ('C') OR VARIABLE ('V')";A$
1510 IF A$="V" THEN 1555
1515 INPUT"VALUE OF CONSTANT";P
1520 IFP<>0 THEN 1535
1525 ?"CAN'T DIVIDE BY ZERO"
1530 GOTO 1515
1535 FOR I=1TOCS
1540 D(I,V)=D(I,V1)/P
1545 NEXT I
1550 RETURN
1555 INPUT"WHICH VARIABLE";V2
1560 FOR I=1TOCS
1565 IF D(I,V2)<>0 THEN 1585
1570 ?"ATTEMPT TO DIVIDE BY ZERO IN CASE ";I
1575 D(I,V)=0
1580 GOTO 1590
1585 D(I,V)=D(I,V1)/D(I,V2)
1590 NEXT I
```

```
32 FORI=1TOVB:GOSUB40:L$(I)=X$:NEXTI
35 FORI=1TOCS:FORJ=1TOVB:GOSUB60:D(I,J)=XX:NEXTJ:NEXTI
37 GOTO 70
40 I9=0:REMRETURN STRING IN X$
45 I9=I9+1
50 SWITCH 2:INPUTSS(I9):SWITCH 3:IFSS(I9)<>255 THEN 45
55 J9=I9-1:X$="":FORI9=1TOJ9:X$=X$+CHR$(SS(I9)):NEXTI9:RETURN
60 GOSUB40:XX=VAL(X$):RETURN:REM LOAD NUMBER
70 TRACE 0:?"DATABASE LOADED":?
99 REM****BEGIN REAL PROGRAM WITH LINE 100
100 REM MENU SUBROUTINE
110 ?"    ***MENU***":?:?"    WOULD YOU LIKE TO:"
120 ?"    REGR-SIMPLE REGRESSION"
130 ?"    CORR-BIVARIATE CORRELATION"
140 ?"    TABL-TWO-WAY TABLE"
150 ?"    COVA-COVARIANCE"
152 ?"    PLOT-TIME PLOT"
155 ?"    STOP-END PROGRAM"
157 INPUT"COMMAND";A$
160 IFA$="REGR"THEN 190
165 IFA$="CORR"THEN 192
170 IFA$="TABL"THEN 194
172 IFA$="PLOT"THEN198
175 IFA$="COVA"THEN 196
177 IFA$="STOP"THEN 9999
178 GOTO110
180 GOTO157
190 GOSUB 200:REM REGR VECTOR
191 GOTO 157
192 GOSUB 400:REM CORR VECTOR
193 GOTO 157
194 GOSUB 600:REM TABL VECTOR
195 GOTO 157
196 GOSUB 500:REM COVA VECTOR
197 GOTO157
198 GOSUB800
199 GOTO157
200 ?:?"    **SIMPLE REGRESSION**":?
205 S1=0:S2=0:S3=0:S4=0:S5=0
210 INPUT"WHICH TWO VARIABLES (DEPENDENT 1ST)";V1,V
220 FORI=1TOCS
230 S1=S1+D(I,V):REM SUM X
240 S2=S2+D(I,V1):REM SUM Y
250 S3=S3+D(I,V)*D(I,V):REM SUM X↑2
260 S4=S4+D(I,V1)*D(I,V1):REM SUM Y↑2
270 S5=S5+D(I,V)*D(I,V1):REM SUMXY
280 NEXT I
290 X=S1*S1:Y=S2/CS:REM (SUM X)↑2 & YBAR
300 A=(S2*S3-S1*S5)/(CS*S3-X)
310 B=(CS*S5-S1*S2)/(CS*S3-X)
320 SE=SQR((S4-A*S2-B*S5)/(CS-2))
330 R2=(A*S2+B*S5-CS*(Y*Y))/(S4-CS*(Y*Y))
340 R=SQR(R2):?:?:?"A=";A;"B=";B
350 ?"SE=";SE;"R=";R;"R-SQR=";R2:?
360 RETURN
400 ?"    LINEAR CORRELATION":?
410 J9=0:K9=0:L9=0:M9=0:R9=0
420 INPUT"WHICH VARIABLES";V,V1:?
430 FORI=1TOCS:J9=J9+D(I,V):K9=K9+D(I,V1)
440 L9=L9+D(I,V)*D(I,V):M9=M9+D(I,V1)*D(I,V1):R9=R9+D(I,V)*D(I,V1)
450 NEXTI
```

```
460 R2=(CS*R9-J9*K9)/SQR((CS*L9-J9*J9)*(CS*M9-K9*K9))
470 ?"COEFFICIENT OF CORRELATION (R)=";R2
480 ?"COEFFICIENT OF DETEMINATION (R↑2)=";R2*R2
490 ?:?:RETURN
500 ?"    **COVARIANCE**":?
510 INPUT"WHICH VARIABLES";V1,V2
520 FORI=1TOCS
530 C1=D(I,V1)*D(I,V2)+C1:REMSUMYX
540 C2=C2+D(I,V1):C3=C3+D(I,V2):NEXTI
550 C8=1/(CS-1)*(C1-(C2*C3/CS)):?
560 ?"COVARIANCE OF VARIABLES";V1;"&";V2;"=";C8:?:RETURN
600 ?:?TAB(15)"***TWO WAY TABLE***":?TAB(15)"CATAGORICAL DATA"
610 FORI=1TO10:A(I)=0:B(I)=0:FORJ=1TO10:T(I,J)=0:NEXTJ:NEXTI
620 INPUT"V# FOR HORIZONTAL AXIS";V
630 INPUT"LOWER & UPPER BOUNDS";B1,B2
640 INPUT"V# FOR VERTICAL AXIS";V1
650 INPUT"LOWER & UPPER BOUNDS";B3,B4
660 FOR I=1 TO CS
670 FORJ=B1TOB2:FORK=B3TOB4
680 IF(D(I,V)=J)AND(D(I,V1)=K)THEN T(K,J)=T(K,J)+1
690 NEXTK:NEXTJ:NEXTI
692 FORI=B1TOB2:FORJ=B3TOB4:A(I)=A(I)+T(I,J):NEXTJ:NEXTI
694 FORI=B3TOB4:FORJ=B1TOB2:B(I)=B(I)+T(J,I):NEXTJ:NEXTI
700 ?:?TAB(15)"***TWO WAY TABLE***":?:?L$(V1);"/";L$(V):?
710 FORJ=B3TOB4:FORI=B1TOB2
720 ?T(J,I);:NEXTI:?A(J):NEXTJ:?
725 FORI=B3TOB4:?B(I);:NEXTI:?
730 RETURN
800 ?"**PLOT**":?
805 INPUT"WHICH VARIABLE";V
810 N=CS-1:MI=D(1,V):MX=D(1,V):REM MIN & MAX
815 FORI=1TON:IFMI<=D((I+1),V)THEN820:ELSEMI=D((I+1),V)
820 IFMX>=D((I+1),V)THEN825:ELSEMX=D((I+1),V)
825 NEXT I
830 DV=INT((MX-MI)/50+1):REM RANGE SCALED TO 50
835 ?:?:?"  PLOT OF VARIABLE";V
840 ?TAB(14);MI;TAB(58);50*DV
845 ?"OBS   VALUE-----------------------------------------------"
850 FORI=1TOCS:J=(D(I,V)-MI)/DV:REM TAB VALUE
855 ?I;TAB(5);D(I,V);TAB(13);"!";TAB(J+15);"*"
860 NEXT I:?:?
865 RETURN
9999 END
```

LISTING 3

```
5 REM **SABR** REGRESSION  BY JOHN LEHMAN   9/78
10 REM THIS MODULE PERFORMS MULTIPLE REGRESSION.  PARTS OF
11 REM THE PROGRAM ARE ADAPTED FROM /COMMOM BASIC PROGRAMS/ P.148
12 REM THE USER CAN READ IN A DATAFILE, SAVE RESIDUALS AND
13 REM EXAMINE THE RESIDUALS
20 DIM V(10),X(10),S(10),T(10),L$(10),A(11,12),R(50),D(25,10),SS(15)
25 ?"  **SABR REGRESSION**":?
28 INPUT"START READER & PRESS A KEY";A$:TRACE 1
30 GOSUB40:T$=X$:GOSUB60:VB=XX:GOSUB60:CS=XX
32 FORI=1TOVB:GOSUB40:L$(I)=X$:NEXTI
35 FORI=1TOCS:FORJ=1TOVB:GOSUB60:D(I,J)=XX:NEXTJ:NEXTI
37 GOTO 80
40 I9=0:REM RETURN STRING IN X$
45 I9=I9+1
720 FORI=2TON+1:P=P+A(I,N+2)*(S(I)-T(I)*S(1)/CS):NEXTI
750 R=S(N+2)-S(1)↑2/CS
760 Z=R-P:L=CS-N-1:I=P/R
790 ?:?TAB(10);"R-SQUARED=";I
800 ?TAB(18);"R=";SQR(I)
810 ?TAB(10);"STD ERROR OF ESTIMATE=";SQR(ABS(Z/L))
900 GOSUB 2000:REM CALCULATE RESIDUALS
1000 ?:?:?"DO YOU WANT TO:"
1010 ?"    SAVE-SAVE RESIDUALS IN THE DATABASE"
1020 ?"    LIST-LIST RESIDUALS"
1030 ?"    HIST-HISTOGRAM OF RESIDUALS"
1040 ?"    RETN-RETURN TO MAIN REGRESSION ROUTINE"
1050 INPUT A$
1070 IF A$="SAVE" THEN GOSUB 2100
1080 IF A$="LIST" THEN GOSUB 2200
1090 IF A$="HIST" THEN GOSUB 2400
1100 IF A$="RETN" THEN 100
1110 GOTO 1000
2000 REM CALCULATE RESIDUALS
2010 FORI=1TOCS
2020 R(I)=A(1,N+2):REM CONSTANT
2030 FOR J=2 TO N+1
2040 R(I)=R(I)+A(J,N+2)*D(I,V(J-1))
2050 NEXT J
2055 R(I)=D(I,V)-R(I)
2060 NEXTI
2070 RETURN
2100 ?"  SAVING RESIDUALS"
2110 VB=VB+1
2120 INPUT"LABEL FOR NEW VARIABLE";L$(VB)
2130 FORI=1TOCS:D(I,VB)=R(I):NEXTI
2140 ?:?"RESIDUALS SAVED AS V(";VB;") ";L$(VB):?
2150 RETURN
2200 ?"        LISTING OF RESIDUALS":?
2210 ?"  Y        Y-HAT      RESIDUAL"
2220 FORI=1TOCS:?D(I,V);:P=A(1,N+2)
2230 FORJ=1TON+1:P=P+A(J,N+2)*D(I,V(J-1)):NEXTJ
2240 ?TAB(10);P;TAB(20);R(I)
2250 NEXTI
2260 ?:?:?:RETURN
2400 ?"  HISTOGRAM AND DESCRIPTIVE STATISTICS OF RESIDUAL"
2410 GOSUB 2500:REM DESC
2420 GOSUB 2600:REM DIST
2430 GOSUB 2700:REM HIST
2440 RETURN
2500 REM ROUTINE DESC CALCULATES MINIMUM (MI),MAX (MX) & MEAN (M)
2510 N1=CS-1
2520 MI=R(1):MX=R(1)
2530 FORI=1TON1:IFMI<=R(I+1)THEN 2540:ELSE MI=R(I+1)
2540 IF MX>=R(I+1) THEN 2550:ELSE MX=R(I+1)
2550 NEXTI
2560 T=0
2570 FORI=1TOCS:T=T+R(I):NEXTI:M=T/CS:REM MEAN
2580 RETURN
2600 REM DISTRIBUTION OF RESIDUALS
2610 GOSUB 2800:REM COMPUTES RANGES OF RESIDUALS IN M5
2620 Q=M5/6:REM IE 6 RANGES
2630 FORI=1TO6:X(I)=MI+I*Q:V(I)=0:NEXTI:REM CALC INTERVALS
2640 FOR I=1TOCS:IF R(I)<X(1) THEN V(1)=V(1)+1
2650 FORJ=2TO6
```

```
50 SWITCH 2:INPUTSS(I9):SWITCH 3:IFSS(I9)<>255 THEN 45
55 J9=I9-1:X$="":FORI9=1TOJ9:X$=X$+CHR$(SS(I9)):NEXTI9:RETURN
60 GOSUB40:XX=VAL(X$):RETURN:REM LOAD NUMBER
80 TRACE 0:?"DATABASE LOADED"
81 ?"POSSIBLE COMMANDS ARE:"
82 ?"    REGR--MULTIPLE REGRESSION"
83 ?"    STOP--END PROGRAM"
84 ?"    SAVE--SAVE DATABASE ON TAPE"
100 ?:?:INPUT"COMMAND";A$
110 IF A$="REGR" THEN GOSUB 200
120 IF A$="SAVE" THEN GOSUB 3000
130 IF A$="STOP" THEN 9999
140 GOTO 81
200 ?"**MULTIPLE REGRESSION**"
205 GOSUB 5000:REM CLEAR ALL VARIABLES
210 INPUT"HOW MANY INDEPENDENT VARIABLE";N
220 ?"ENTER VARIABLE NUMBERS, DEPENDENT FIRST"
230 INPUT V:FORI=1TON:INPUT V(I):NEXTI
240 X(1)=1
250 FORI=1TOCS:FORJ=1TON
270 X(J+1)=D(I,V(J))
280 NEXTJ
290 X(N+2)=D(I,V):REM DEP VAR
300 FOR K=1TON+1:FOR L=1TON+2
320 A(K,L)=A(K,L)+X(K)*X(L):S(K)=A(K,N+2)
340 NEXT L
350 NEXT K
360 S(N+2)=S(N+2)+X(N+2)↑2
370 NEXT I
380 REM SOLVE SYSTEM OF EQUATIONS IN A()
390 FOR I=2TO N+1
400 T(I)=A(1,I)
410 NEXTI
420 FOR I=1TON+1
430 FOR J=I TO N+1
440 IF A(J,I)<>0 THEN 480
450 NEXT J
460 ?"MATRIX SINGULAR":?
470 RETURN
480 FOR K=1 TO N+2
490 B=A(I,K):A(I,K)=A(J,K):A(J,K)=B
520 NEXT K
530 Z=1/A(I,I)
540 FORK=1TO N+2
550 A(I,K)=Z*A(I,K)
560 NEXTK
570 FOR J=1TON+1
580 IF J=I THEN 630
590 Z=-A(J,I)
600 FOR K=1TON+2:A(J,K)=A(J,K)+Z*A(I,K)
620 NEXTK
630 NEXTJ
640 NEXT I
650 ?:?:?
660 ?TAB(10);"EQUATION COEFFICIENTS":?
670 ?TAB(10);"CONSTANT=";A(1,N+2)
680 FORI=2TON+1
690 ?TAB(10);"V(";V(I-1);") (";L$(V(I-1));")=";A(I,N+2)
700 NEXT I
710 P=0
```

```
2660 IF NOT(R(I)<X(J)) THEN 2680
2670 IF R(I)<X(J-1) THEN 2680
2675 V(J)=V(J)+1
2680 NEXT J
2690 NEXTI
2695 RETURN
2700 REM SUBROUTINE HIST
2710 P$="*******************************************************************"
2720 ?:?"     HISTOGRAM":?
2730 ?"MINIMUM=";MI;TAB(30);"MAXIMUM=";MX
2740 ?"MEAN=";M
2750 J=1:REM COUNT
2760 FORI=1TO6:IFV(I)>60 THEN J=2:IFV(I)>120THENJ=3
2770 IFV(I)>180THENJ=4:IFV(I)>240THENJ=5:NEXTI
2780 ?"UPPER BOUND":?
2790 FORI=1TO6:Q1=V(I)/J:A$=LEFT$(P$,Q1):?X(I);TAB(5);"+";A$:NEXTI
2795 RETURN
2800 REM ROUTINE TO COMPUTE RANGE
2810 M5=MX-MI:RETURN
3000 REM SUBROUTINE TO SAVE FILES ON TAPE.  FORMAT IS FILE-LABEL,
3010 REM #V,#C,INDIVIDUAL LABELS,V1C1,V1C2,ETC.
3020 INPUT"START PUNCH & PRESS A KEY";A$
3021 TRACE 1
3030 X$=T$:GOSUB3070:XX=VB:GOSUB3100:XX=CS:GOSUB3100
3040 FORI=1TOVB:X$=L$(I):GOSUB3070:NEXTI
3050 FORI=1TOCS:FORJ=1TOVB:XX=D(I,J):GOSUB3100:NEXTJ:NEXTI
3060 TRACE 0:?"DATABASE SAVED":GOTO 100
3070 REM STRING SAVE IN X$
3080 FORI9=1TOLEN(X$):SS(I9)=ASC(MID$(X$,I9,1)):NEXTI9:SS(I9)=255
3090 FORI9=1TOLEN(X$)+1:LPRINTSS(I9):FORK9=1TO75:NEXTK9:NEXTI9
3095 RETURN
3100 X$=STR$(XX):GOSUB3070:RETURN:REM NUMBER SAVE IN XX
5000 REM CLEAR VARIABLES
5010 FORI=1TOVB:V(I)=0:X(I)=0:S(I)=0:T(I)=0:NEXTI
5020 FORI=1TOVB+1:FORJ=1TOVB+2:A(I,J)=0:NEXTJ:NEXTI
5030 RETURN
9999 END
```

LISTING 4

```
ALTERNATIVE DATA SAVING AND LOADING ROUTINES
FOR USE WITH A CONTROLLED READER/PUNCH
800 REM SUBROUTINE TO SAVE FILES ON TAPE.  FORMAT IS FILE-LABEL,
801 REM #V,#C,INDIVIDUAL LABELS,V1C1,V1C2,ETC.
810 ?:?"**STARTING SAVE**"
815 INPUT"START PUNCH & PRESS A KEY WHEN READY";A$
820 LPRINT T$:LPRINTVB:LPRINTCS
825 FORI=1TOVB:LPRINTL$(I):NEXTI
830 FORI=1TOCS:FORJ=1TOVB:LPRINTD(I,J):NEXTJ:NEXTI
835 ?"DATABASE SAVED":RETURN
900 REM SUBROUTINE TO LOAD A FILE FROM TAPE
905 INPUT"START READER AND PRESS A KEY";A$:TRACE 1
910 SWITCH2:INPUTT$:INPUTVB:INPUTCS
915 FORI=1TOVB:INPUTL$(I):NEXTI
920 FORI=1TOCS:FORJ=1TOVB:INPUTD(I,J):NEXTJ:NEXTI
925 SWITCH 3
930 ?"LOADED"
```

SALES RECORD KEEPING

By David R. Witt

As any salesman knows, the secret to survival in sales is keeping track of all the prospects in all the cities of his territory complete with all the information about each and the details about the transaction. All this information must be at his fingertips. Using a micro to save time and keep all this data is the perfect solution.

Presented here are programs being used to do the record keeping for a salesman of capital equipment to hospitals in three states. For example, every day he has to call on prospects and not only know their names and phone numbers, but know what they discussed the last time and what instruments they have and want. This requires accurate records, but also records that are immediately accessible.

Running a weekly PLIST program of each state the salesman operates in gives all the information needed. All that is required is for him to continue to update the records. Once this is done, no further effort is required to generate monthly reports of sales, prospects, instrument needs forecast, competition activity and many others.

Using the R1$ prospect code to store the code for users, prospects or lost sales, and using the P1$ instrument to store the code for the instrument involved makes it easy to generate these types of reports.

The random access database created and maintained by these programs is limited only by the size of system in use. Two files are created for the database: CLIENT1 which is all the routine information plus the type instrumentation involved, and CLIENT2 which only contains the comments about the clients such as when to call or demo. This file can be deleted in a system that will not support multiple file access simultaneously. The next call data can be kept in G1$. On the other hand there is room in CLIENT2 for much more data in Z1$.

Many modifications to this system are possible, including the use of multiple disk drives. The BASIC used is MITS on a MITS system with 48K memory, one disk drive and a QUME printer. By using the SALES program to input records, a database is built. This is the main program and the screen display on lines 110-230 is displayed whenever any function is completed or when the program is booted up. So, after start-up no programming knowledge is needed to run any of the functions.

Each record is written and using D1$ as a marker, the record is noted as being in use, open, or deleted. In the input routine the number of the last record written is stored in REF FILE so that the current next-open record number is used automatically. Other default information can be kept here as well.

The change in previously stored files is done by the CHANGE program but is called by the SALES program menu. To change a part of the record, hit return when good data is displayed and type in new data in place of the data that is to be changed. The new information will have the same record number as before. A great many types of reports are possible using the basic structure of the PLIST programs and changing the extraction parameters. It is possible to search for a record or select and print a record using the appropriate file.

Used in A1$ and E1$ are the string to integer conversions, so sort operations can be done by Zip Code. This can be extended to area code as well. To sort by Zip, change line 200 to 200 BL$=MID$(Z$(L),30,4) and change line 210 in a similar manner. Also add BL=CVS(E1$) for BL$ and BI$. The structure of this extraction and sort program will support many types of operations by changing the variables used.

Included is a chart of the variables used in the database. There is nothing that cannot be adapted to another type of product. There is also much room for data that is unused in the CLIENT2 file.

One problem may be encountered in a system of lesser memory in the sorting program. It can be overcome by modifying the program to do the extraction and place the records in a subfile, then use the sort routine of the program to sort the subfile.

The L INST, and the PLIST XX programs are missing because they are the same as the PLIST KS program except the variable used in line 130 or 140 is changed as is also true of the LTLIST program which only deletes lines 130-140, and of course the headers in lines 270-300.☐

ABOUT THE AUTHOR

David R. Witt is a Sales Engineer for Gilford Instruments in the midwest. He has a MITS system, and uses BASIC to write many types of applications software. He has a Masters degree in Management, a Bachelors degree in Medical Technology, and has over 10 years experience in laboratory management and sales.

PROGRAM 1

```
10 'SALES
20 PRINTCHR$(26)
30 CLEAR2000
40 'PROGRAM MENU AND MAIN FUNCTIONS
50 OPEN"R",#1,"CLIENT1",0
60 OPEN"R",#2,"CLIENT2",0
70 OPEN"R",#3,"REF FILE",0
80 FIELD#1, 2 AS A1$,26 AS B1$,1 AS D1$,4 AS E1$,8 AS G1$,1 AS H1$,
20 AS K1$,15 AS L1$,2 AS M1$,12 AS N1$,8 AS P1$,
26 AS Q1$,3 AS R1$
90 FIELD #2, 2 AS A2$,80 AS X2$,46 AS Z2$
100 FIELD#3,4 AS C3$,124 AS Z3$
110 PRINTCHR$(26)
120 PRINT:PRINT:PRINT"          SALES ORGANIZATION RECORDS SYSTEM"
130 PRINT:PRINT"SELECT THE FUNCTION DESIRED AS FOLLOWS:"
140 PRINT:PRINT"     E= EXAMINE A RECORD"
150 PRINT:PRINT"     D= DELETE A RECORD"
160 PRINT:PRINT"     I= INPUT A NEW RECORD"
170 PRINT:PRINT"     C= CHANGE DATA IN A RECORD"
180 PRINT:PRINT"     P= PRINT PROSPECT LIST ON LINE PRINTER"
190 PRINT:PRINT"     T= PRINT ALL RECORDS ON LINE PRINTER":PRINT
200 PRINT"     S= SEARCH FOR RECORD # BY HS NAME"
210 PRINT:PRINT"     M= 3500 PROSPECT LIST"
220 PRINT:PRINT"     Q= LIST OF COMMANDS":PRINT
230 INPUT"COMMAND "; C$
240 IF C$="E" THEN 350
250 IF C$="D" THEN 490
260 IF C$="I" THEN 550
270 IF C$="C" THEN 930
280 IF C$="P" THEN 940
290 IF C$="T" THEN 990
300 IF C$="S" THEN 1000
310 IF C$="M" THEN 1010
320 IF C$="Q" THEN GOTO 110
330 PRINT"INVALID COMMAND"
340 GOTO 230
350 INPUT"WHAT RECORD TO EXAMINE ";A
360 GET #1, A
370 GET #2, A
380 IF CVI(A1$) = 0 THEN PRINT "EMPTY RECORD":GOTO 230
390 IF D1$<> " " THEN PRINT "DELETED RECORD":GOTO 230
400 PRINT"RECORD";CVI(A1$),B1$,G1$
410 PRINT Q1$,H1$
420 PRINT K1$,N1$
430  E1=CVS(E1$)
440 PRINT L1$;", ";M1$,E1
450 PRINT P1$,R1$
460 PRINT
470 PRINT;X2$:PRINT
480 GOTO230
490 INPUT"WHAT RECORD TO DELETE ";A
500 GET#1, A
510 LSET D1$="X" 'SET TO DELETE INDICATION
520 PUT#1, A
530 PRINT
540 GOTO230
550 GET#3,1
560 A=CVI(C3$)+1
570 PRINT"NEW RECORD # INPUT IS  ";A
580  GET#1,A
590 IF D1$=" " THEN PRINT "RECORD IN USE":GOTO 230
600 LSET C3$=MKI$(A)
610 PUT#3,1
620 LSET D1$=" "  'SET TO IN USE THIS RECORD #
630 LSET A1$= MKI$(A)
640 PRINT "CONTACT'S NAME "
650 LINE INPUT B$:LSETB1$=B$
660 LSET B1$=B$
670 INPUT"DATE OF LAST CONTACT (MM/DD/YR) ";G$
680 LSETG1$=G$
690 PRINT:PRINT"           HOSPITAL TYPE IS AS FOLLOWS:"
700 PRINT"          P= PRIVATE INST"
710 PRINT"          M= MUNICIPAL HS"
720 PRINT"          F= FEDERAL INST"
730 PRINT"          U= UNIVERSITY"
740 PRINT"          C= CLINIC"
750 PRINT"          H= MENTAL HS"
760 INPUT"HOSPITAL TYPE (P/M/F/C)";H$:LSETH1$=H$
770 PRINT"STREET ADDRESS":LINE INPUTK$:LSETK1$=K$
780 INPUT"GIVE ME CITY, STATE";L$,M$:LSETL1$=L$:LSETM1$=M$
790 INPUT"GIVE ME ZIP CODE";E:LSETE1$=MKS$(E)
800 INPUT"Phone Number ";N$
810 LSETN1$=N$
820 INPUT"INSTRAMENT ";P$:LSETP1$=P$
830 PRINT"IN HOSPITAL NAME USE STD ABBRIEVIATIONS"
840 PRINT"HS= HOSPITAL, MEM= MEMORIAL, UN= UNIVERSITY"
850 INPUT"HOSPITAL NAME ";Q$:LSETQ1$=Q$
860 INPUT"PROSPECT ";R$:LSETR1$=R$
870 INPUT"COMMENTS ";X3$:LSETX2$=X3$
880 PUT #1, A
890 A2$=A1$
900 PUT #2, A
910 PRINT
920 GOTO 230
930 RUN"CHANGE",0
940 INPUT"PROSPECT LIST FOR WHICH STATE (KS,NE,IA) ";S$
950 IF S$="KS" THEN RUN"PLIST KS",0
960 IF S$="IA" THEN RUN"PLIST IA",0
970 IF S$="NE" THEN RUN"PLIST NE",0
980 GOTO 940
990 RUN"LTLIST",0
1000 RUN"SEARCH",0
1010 RUN"L INST",0
```

PROGRAM 2

```
10 'CHANGE
20 PRINTCHR$(26)
30 CLEAR2000
40 'PROGRAM TO CHANGE 'CLIENT' FILES
50 OPEN"R",#1,"CLIENT1",0
60 OPEN"R",#2,"CLIENT2",0
70 FIELD#1, 2 AS A1$,26 AS B1$,1 AS D1$,4 AS E1$,8 AS G1$,1 AS H1$,
20 AS K1$,15 AS L1$,2 AS M1$,12 AS N1$,8 AS P1$,
26 AS Q1$,3 AS R1$
80 FIELD#2, 2 AS A2$,80 AS X2$,46 AS Z2$
90 INPUT"CUST # TO BE CHANGED"; A
100 A$=" ":T$=" ":U$=" ":V$=" ":X$=" ":Y$=" ":  Z$=" ":R$=" ":S$=" "
110 G2$=" "
120 X4$=" "
130 U=0
140 GET #1, A
150 GET #2, A
160 IF CVI(A1$) = 0 THEN PRINT "EMPTY RECORD":GOTO 90
170 IF D1$<> " " THEN PRINT "DELETED RECORD":GOTO 90
180 PRINT"RECORD";CVI(A1$),B1$,G1$
190 PRINT Q1$,H1$
200 PRINT K1$,N1$
210  E1=CVS(E1$)
220 PRINT L1$;", ";M1$,E1
230 PRINT P1$,R1$
240 PRINT
250 PRINT;X2$:PRINT
260 INPUT"CONTACT'S NAME ";T$
270 IF T$=" "THEN 290
280 LSET B1$=T$
290 INPUT"DATE OF LAST CONTACT (MM/DD/YR) ";U$
300 IF U$=" "THEN 320
310 LSETG1$=U$
320 INPUT"HOSPITAL TYPE (P/M/F/C/U)";V$
330 IF V$=" "THEN 350
340 LSETH1$=V$
350 INPUT"STREET ADDRESS";X$
360 IF X$=" "THEN 380
370 LSETK1$=X$
380 INPUT"GIVE ME CITY, STATE";Y$,Z$
390 IF Y$=" "THEN 410
400 LSETL1$=Y$:LSETM1$=Z$
410 INPUT"GIVE ME ZIP CODE";U
420 IF U=0 THEN 440
430 LSETE1$=MKS$(U)
440 INPUT"Phone Number ";R$
450 IF R$=" "THEN 470
460 LSETN1$=R$
470 INPUT"INSTRAMENT ";A$
480 IF A$=" "THEN 500
490 LSETP1$=A$
500 INPUT"HOSPITAL ";S$
510 IF S$=" "THEN530
520 LSETQ1$=S$
530 INPUT"PROSPECT ";G2$
540 IF G2$=" "THEN 560
550 LSET R1$=G2$
560 INPUT"COMMENTS: ";X4$
570 IF X4$=" "THEN 590
580 LSETX2$=X4$
590 PUT #1, A
600 A2$=A1$
610 PUT #2, A
620 PRINT
630 INPUT"CHANGE ANOTHER (1=YES/ 0=NO) ";R9
640 IF R9=1 THEN 90
650 RUN"SALES",0
```

```
500 IF CVI(A1$) = 0 THEN PRINT "EMPTY RECORD":GOTO 730
510 IF D1$<> " " THEN PRINT "DELETED RECORD":GOTO 730
520 IF R1$<>"P  " THEN PRINT "NOT PROSPECT":GOTO 730
530 IF M1$<>"KS" THEN PRINT "NOT KS":GOTO 730
540 LPRINT"          RECORD";CVI(A1$),B1$,G1$
550 H$=" "
560 IF H1$="M"THEN H$="MUNICIPAL"
570 IF H1$="F"THEN H$="FEDERAL"
580 IF H1$="U"THEN H$="UNIVERSITY"
590 IF H1$="C"THEN H$="CLINIC"
600 IF H1$="P"THEN H$="PRIVATE INST"
610 IF H1$="H"THEN H$="MENTAL HS"
620 LPRINT"            "; Q1$,H$
630 LPRINT"            "; K1$,N1$
640  E1=CVS(E1$)
650 LPRINT"            "; L1$;", ";M1$,E1
660 LPRINT"            "; P1$
670 LPRINT
680 LPRINT"            "; X3$
690 LPRINT
700 LPRINT"            ----------------------------------------------"
710 P6=P6+1  'ROUTINE TO PAGINATE THE LIST FOR 8.5X11 PAPER
720 IF P6=6 THEN GOSUB 750
730 NEXTI
740 RUN"SALES",0
750 FOR K=1 TO 10
760 LPRINT
770 NEXT K
780 P6=0
790 RETURN
```

PROGRAM 4

```
10 'SEARCH
20 ' SEARCH FOR RECORD NUMBER BY HS NAME
30 PRINTCHR$(26)
40 OPEN"R",2,"CLIENT1",0
50 FIELD#2, 2 AS A2$,26 AS B2$,1 AS D2$,4 AS E2$,8 AS G2$,1 AS H2$,
20 AS K2$,15 AS L2$,2 AS M2$,12 AS N2$,8 AS P2$,
26 AS Q2$,3 AS R2$
60  INPUT"HOSPITAL NAME TO SEARCH FOR ";M$
70 Z=LEN(M$)
80 X=26-Z
90 M$=M$+STRING$(X,32)   'FILL IN SPACES IN STRING
100 PRINT
110 PRINT"LOOKING"
120 GET#2
130 A2=CVI(A2$)
140 IF A2=0 THEN 220
150 IF D2$<>" " THEN 120
160 IF Q2$<>M$ THEN 120
170 PRINTTAB(20);"RECORD # ";A2;;Q2$
180 PRINT
190 INPUT"WANT ANOTHER (Y=YES) ";S$
200 IFS$="Y"THEN 220
210 RUN"SALES",0
220 CLOSE:GOTO40
```

PROGRAM 3

```
10 'PLIST KS
20 'PROGRAM TO EXTRACT PROSPECTS AND SORT BY CITY
30 CLEAR 10000
40 DIMZ$(100)
50 OPEN"R",2,"CLIENT1",0
60 OPEN"R",3,"CLIENT2",0
70 FIELD#2, 2 AS A2$,26 AS B2$,1 AS D2$,4 AS E2$,8 AS G2$,1 AS H2$,
20 AS K2$,15 AS L2$,2 AS M2$,12 AS N2$,8 AS P2$,
26 AS Q2$,3 AS R2$
80 FIELD #3,2 AS A3$,126 AS X3$
90 GET#2
100 A2=CVI(A2$)
110 IF A2=0 THEN 180
120 IF D2$<>" " THEN 90
130 IF R2$<>"P  " THEN 90  'THE P DESIGNATES PROSPECT
140 IF M2$<>"KS" THEN 90
150 K=K+1
160 Z$(K)=A2$+B2$+D2$+E2$+G2$+H2$+K2$+L2$+M2$+N2$+P2$+Q2$+R2$
170 GOTO90
180 FORI=1 TO K
190 FOR L=I TO K
200 BL$=MID$(Z$(L),63,15)
210 BI$=MID$(Z$(I),63,15)
220 IF BL$<BI$ THEN SWAP Z$(L),Z$(I):GOTO 240
230 IF BL$>BI$ THEN 240
240 NEXTL
250 NEXTI
260 PRINTCHR$(26)
270 INPUT"WHAT IS THE DATE ";Y$
280 LPRINT"                                  ";Y$;"    KANSAS"
290 LPRINT
300 LPRINT"                           PROSPECT LIST TERRITORY 258"
310 LPRINT:LPRINT:LPRINT
320 P6=0
330 FORI=1 TOK
340 'CONVERT Z$(I) TO FIELD
350 A1$=MID$(Z$(I),1,2)
360 B1$=MID$(Z$(I),3,26)
370 D1$=MID$(Z$(I),29,1)
380 E1$=MID$(Z$(I),30,4)
390 G1$=MID$(Z$(I),34,8)
400 H1$=MID$(Z$(I),42,1)
410 K1$=MID$(Z$(I),43,20)
420 L1$=MID$(Z$(I),63,15)
430 M1$=MID$(Z$(I),78,2)
440 N1$=MID$(Z$(I),80,12)
450 P1$=MID$(Z$(I),92,8)
460 Q1$=MID$(Z$(I),100,26)
470 R1$=MID$(Z$(I),126,3)
480 A=CVI(A1$)
490 GET #3, A
```

```
5 'SELECT
10 PRINTCHR$(26)
20 CLEAR2000
30 'LIST SELECTED RECORDS
40 OPEN"R",#1,"CLIENT1",0
50 OPEN"R",#2,"CLIENT2",0
60 FIELD#1, 2 AS A1$,26 AS B1$,1 AS D1$,4 AS E1$,8 AS G1$,1 AS H1$,
20 AS K1$,15 AS L1$,2 AS M1$,12 AS N1$,8 AS P1$,
26 AS Q1$,3 AS R1$
70 FIELD#2, 2 AS A2$,80 AS X2$,46 AS Z2$
80 INPUT"RECORD NUMBER TO LPRINT ";A
90 GET #1, A
100 GET #2, A
110 IF CVI(A1$) = 0 THEN PRINT "EMPTY RECORD":GOTO 310
120 IF DI$<> " " THEN PRINT "DELETED RECORD":GOTO 310
130 INPUT"INSERT PAPER & LINE UP TO PRINT (RETURN)  ";R9$
140 LPRINT"RECORD";CVI(A1$),B1$,G1$
150 H$=" "
160 IF H1$="M" THEN H$="MUNICIPAL"
170 IF H1$="F" THEN H$="FEDERAL"
180 IF H1$="U" THEN H$="UNIVERSITY"
190 IF H1$="C" THEN H$="CLINIC"
200 IF H1$="P" THEN H$="PRIVATE INST"
210 IF H1$="H" THEN H$="MENTAL HS"
220 LPRINT Q1$,H$
230 LPRINT K1$,N1$
240  E1=CVS(E1$)
250 LPRINT L1$;", ";M1$,E1
260 LPRINT P1$,R1$
270 LPRINT
280 LPRINT X2$:LPRINT
290 LPRINT
300 LPRINT"--------------------------------------------------
----------------":LPRINT
310 INPUT"ANOTHER ONE ";CR$
320 IF CR$="YES" THEN 80
330 RUN"SALES",0
```

```
FIELD VARIABLES LIST
---------------------------------
VAR  |       MEANING
---------------------------------
A1$         RECORD NUMBER
B1$         PERSONS NAME
D1$         FILE CONDITION
E1$         ZIP CODE
G1$         DATE OF LAST CONTACT
H1$         TYPE OF INSTITUTION
K1$         STREET ADDRESS
L1$         CITY
M1$         STATE
N1$         PHONE NUMBER
P1$         INSTRUMENT
Q1$         NAME OF INSTITUTION
R1$          PROSPECT CODE
X2$         COMMENTS
Z2$         UNUSED FILE SPACE
---------------------------------
```

MICROCOMPUTER ANALYSIS OF RETURN ON INVESTMENT

By Timothy J. Burke

Business managers responsible for investment decisions are often faced with the task of selecting a course of action from among several alternatives, each of which may initially seem attractive. When the decision involves a major capital investment, the challenge becomes one of selecting the alternative most likely to yield the greatest return on investment. In pursuit of this goal, many managers will utilize rather sophisticated methods to analyze the projected returns on the investment alternatives. The individual investor, who shares many of the same goals, in the past usually did not have access to the computer technology required to make these kind of analyses. With the advent of the pocket calculator, and more recently the personal microcomputer, sophisticated computations can now be performed by virtually all small investors.

We have developed a microcomputer program capable of analyzing the projected rate of return (ROR) for the small investor. The program is written in Alpha-BASIC, and is designed for use on an Alpha-Micro computer system, but similar versions are available for PET, CP/M, TRS-80, Sorcerer, and Apple computers. The memory requirements are 8K of memory above and beyond that of the BASIC and operating systems.

The program can be used to analyze the return on an investment from three vantage points: (1) the Net Present Value of the Investment, (2) the Internal Rate of Return (IRR), and (3) the Adjusted Internal Rate of Return (AIRR). All three of these analytical models are particularly useful for those engaged in real estate investment, but they need not be limited to that application. The program can be used to analyze any investment for which future income projections are available, and is particularly useful where the income will be generated in irregular amounts or at irregular intervals.

Prior to explaining the program in more detail, it would perhaps be helpful to briefly review some of the basic concepts of investment analysis. There are many different ways to analyze the return on an investment. These are the most common.

CAPITALIZATION RATE

This can be defined as the "free and clear" cash flow (i.e. after debt service) divided by the purchase price. A simple example would be a property with a free and clear cash flow of $90,000 and a purchase price of $1,000,000. The capitalization rate would be nine percent, calculated as follows:

$$\text{Capitalization Rate} = \frac{\text{free and clear cash flow}}{\text{purchase price}} = \frac{90,000}{1,000,000} = 9\%$$

Use of the capitalization process is fundamental to many areas of finance, but most notably to the income method of appraisal in real estate valuation. Used in this manner, the value of a property is estimated from the amount of income it produces, assuming a capitalization rate that is reasonable for the type of property involved. In the way that the term is used here, however, the capitalization rate itself is the unknown, while the purchase price of the property and the free and clear cash flow will generally be known or can be reasonably estimated.

The capitalization rate provides a fairly accurate measure of the return in those instances where there is an intial investment of a fixed amount and the return is received in equal annual installments. To the extent that the cash flow departs from this pattern, the capitalization rate will be somewhat distorted as a measure of the true return. One reason for this is that the timing of the receipt of income is important.

PAYBACK PERIOD

This is the period of time required to recover the investment. A $10,000 project with annual distributions of $2,500 for five years would have a four-year payback period ($10,000 divided by $2,500). It is sometimes required that an investment proposal have a payback period of a certain period of time. Furthermore, it is not uncommon for a particular project to be selected from among a number of alternatives because it has the shortest payback period.

The payback period analysis is useful mainly in identifying the period of time that the invested funds would be at risk. Most investors are interested in receiving more than just the return of their invested capital. Nevertheless, some investors will prefer, for a variety of reasons, an investment with a rapid payback period rather than one with a slower payback period that will generate more in total income.

ACCOUNTING RETURN

This is the sum of all of the returns less the amount of the initial investment, divided by the term of the investment (expressed in years), all of which is divided by the amount of the initial investment. In the case of the $10,000 investment previously discussed, the accounting return would be calculated as follows:

$$\text{Accounting Return} = \frac{\dfrac{5(2500) - 10,000}{5}}{10,000} = \frac{500}{10,000} = 5\%$$

The determination of the accounting return, unlike that of the payback period, takes into account all of the payments received over the entire term of the investment.

The capitalization rate, the payback period, and the accounting return represent three important ways of approaching a prospective investment. While each can provide certain perspectives, none incorporates all of the elements that might be desired in a comprehensive and meaningful measure of the return on an investment. It is therefore appropriate to identify some of the factors that should be taken into account by such a measure. Among them are:

1. The amount, timing and ultimate tax consequences of the initial capital investment.
2. The subsequent tax benefits and liabilities generated over the entire term of the investment.
3. All cash flows from operations over the entire term of the investment.
4. The proceeds of deficits created by the sale of the income-producing property, while allowing for all of the tax consequences. In certain cases this will include capital gains tax as well as the ordinary income tax liability arising from

the recapture of the excess of accelerated depreciation over straight-line depreciation.

5. The recognition of the time value of money. A dollar received today is more valuable than a dollar to be received a year from now.

None of the previously discussed measures of return on investment satisfy all of these criteria. Their chief shortcomings include the recognition of equity build-up and appreciation prior to the time they are actually received in cash, the use of average figures, the failure to account for all of the cash and tax consequences over the entire investment cycle, and the failure to take into account the present value of income to be received in the future.

Perhaps the most significant of these defects, as well as the most easily remedied, is the failure to utilize present value theory. This can be accomplished by "discounting" all future cash flows to reflect their present values. The face value of each future cash flow is multiplied by the appropriate discount factor. The discount factor is determined by two variables: (1) how long into the future the payment is deferred, and (2) the required interest rate or rate of return. For any given interest rate and time period, the discount factor can be computed according to the following formula:

$$\text{Discount Factor} = \frac{1}{(1+r)^t}$$

where: r = the annual simple rate of interest
t = time period (in years) the payment is deferred

Using this formula, the discount factor for a payment to be received a year from today, assuming a ten percent required rate of interest, would be 0.909, while the factor for a payment received two years hence would be 0.826.

$$\frac{1}{(1+0.1)^1} = \frac{1}{1.1} = 0.909; \quad \frac{1}{(1+0.1)^2} = \frac{1}{1.21} = 0.826$$

It is obvious from these examples that the discount factor varies inversely with the required rate of return and with the length of time over which the payment is deferred. Therefore, the present value of a future payment decreases when either the time period or the interest rate is increased.

There are several models of investment analysis that utilize present value theory. Among the most important of these are Net Present Value, Internal Rate of Return, and Adjusted Internal Rate of Return.

NET PRESENT VALUE

To use this method it is necessary to calculate not only the present value of the proceeds expected from the investment, but also the present value of all of the outlays expected to be made during the term of the investment. The difference between the present value of the proceeds (the positive cash flow) and the present value of the outlays (the negative cash flow) is the Net Present Value of the investment. The negative cash flow generally includes the amount originally invested as well as any subsequent expenses or losses incurred.

The process of calculating the present value of a cash flow or stream of income begins with the selection of the required rate of return. This is the rate that we hope to achieve from the investments. Once it is determined, it is possible to calculate the discount factor for any future date when income will be received (an inflow) or an expense will be paid (an outflow).

To illustrate this concept, begin with a relatively straightforward example of a series of positive cash flows. An investment is expected to generate, in four annual installments, income in the amounts of $700, $400, $900, and $200. The required rate of return is 10 percent. The present value of these annual distributions would be:

Period	Inflows	Discount Factor	Present Value
1	$700	0.909	$ 636
2	$400	0.826	$ 330
3	$900	0.751	$ 676
4	$200	0.683	$ 137
			$1,779

This series of positive cash flows has a present value of $1,779. This particular investment would be desirable if it could be purchased for $1,779. If so, the desired 10 percent rate of return could be realized. If the investment could be purchased for less than $1,779, it would be earning income at a rate greater than 10 percent, while if it cost more it would be yielding less.

It is interesting to compare the results achieved using a present value method of analysis with the results achieved using the accounting rate of return method. If the previously mentioned income stream was purchased for $1,779, that would translate into a 10 percent rate of return under present value theory. The accounting return, however, would be something less than 10 percent. Since the sum of the four payments in the hypothetical is $2,200, the accounting return would be:

$$\text{Accounting Return} = \frac{\dfrac{2{,}200 - 1{,}779}{4}}{1{,}779} = 5.9\%$$

The fact that the accounting return is less than the return calculated according to the present value method further illustrates the effects attributable to the time value of money. Under the accounting return method, the payment at the end of Year 4 is valued in the same way as the payment received at the end of Year 1. According to present value theory, however, a dollar received at the end of Year 4 is worth only about 75% as much as a dollar received at the end of year 1 (0.683/0.909 = 75%), using a 10 percent discount rate. The present value model emphasizes discounted cash flows rather than accounting income taken at face value.

As stated earlier, the Net Present Value is derived not only from the cash inflows, but also from the cash outflows associated with any investment. If we further develop the hypothetical by introducing some outflows, we would then be able to determine the Net Present Value.

The primary outflow for most investments will be the initial capital outlay. Assume that the investment was purchased for $1,300, which means that in Year 0 it had a negative present value of $1,300. Assume further that the only other anticipated outflow will be in the amount of $500 at the end of Year 5. This negative value at the end of the investment period might represent, for example, a loss of $500 realized on the sale of the income-producing property. It should also be noted that the terms "inflow' and "outflow" refer to the net cash flow for any given year. Thus, a year in which income was earned in the amount of $900, and in which $600 worth of expenses were paid, would be characterized as having a cash inflow of $300. We can therefore assume that in Year 5 a loss of $500 was incurred and that no income was earned. Given these facts, the present value of the negative cash flow of this investment is calculated as follows:

Period	Outflow	Discount Factor	Present Value
0	$1,300	1.000	$1,300
5	$ 500	0.621	$ 310
			$1,610

The Net Present Value of the investment is simply the difference between the present values of the positive and negative cash flows. Hence:

Present value of positive flow	$+1,779
Present value of negative flow	$-1,610
Net Present Value	$+ 169

This particular investment has a Net Present Value of $+169. Since this value is positive, a net gain will be realized from the investment. Beyond that, the Net Present Value figure may not really tell us much. The average investor needs a basis for comparing investment alternatives, and the Net Present Value Model does not readily facilitate such a comparison. Furthermore, there is some element of risk in virtually every investment, but the analytical models presented here do not attempt to incorporate the risk factor.

PROFITABILITY INDEX

There is a tool, however, that can be used to compare the relative desirability of various investments. It is the Profitability Index, which is simply the ratio of the present value of the positive flow divided by the present value of the negative flow. The Profitability Index for our hypothetical would be:

$$\text{P.I.} = \frac{\text{Present Value of positive inflows}}{\text{Present Value of negative outflows}} = \frac{\$1{,}779}{\$1{,}610} = 1.1$$

The fact that the Index is greater than one indicates that an investment with cash flows of $-1300, $+700, $+400, $+900, $+200, and $-500 has an actual rate of return in excess of the desired 10 percent. When the Index is less than one, this means that the desired rate of return will not be achieved. If a 10 percent return is the sole criterion, then this investment would be selected.

INTERNAL RATE OF RETURN (IRR)

This measure can be defined as that interest rate which, when plugged into the discount factor formula, will cause the discounted value of the positive flow to equal the discounted value of the negative flow of a given investment. Since the IRR equates the present value of the positive and negative flows, it can also be interpreted as the rate that causes the Net Present Value to be zero. The equation could thus be expressed as follows, using summation notation:

$$0 = \sum_{t=0}^{n} \frac{1}{(1+r)^{t}} \text{ (net cash flow — t)}$$

Where: n = total number of years in investment period
t = year of cash flow
r = Internal Rate of Return
"net cash flow — t" = the net cash flow realized in Year t.

An important consideration in computing the Internal Rate of Return is the assumption of the reinvestment interest rate. Basically this means that it is assumed that all cash inflows are reinvested in investments yielding a return equal to the Internal Rate of Return. This reinvestment process can be compared to an ordinary savings account.

While the reinvestment assumption is valid for some investments, it will not necessarily accurately reflect the true nature of other investments. The net effect of the reinvestment assumption is that it can tend to make good investments appear to be better than they actually are and make poor investments look worse. The Internal Rate of Return nevertheless remains a useful analytic tool for screening investment alternatives, so long as the user realizes that the actual yield on reinvested funds may not be equivalent to the Internal Rate of Return.

The computational process required to derive the internal rate of return can be quite cumbersome. This is due largely to the fact that a series of iterations must be performed in order to identify the precise interest rate that will solve the IRR equation. The process is essentially one of trial and error, and consequently can become quite tedious. In addition, multiple changes of sign (sequential changes from negative to positive to negative, etc.) must be dealt with, and this can present some problems. The use of a microcomputer can be a real boon in this area.

ADJUSTED INTERNAL RATE OF RETURN (AIRR)

This model is similar to the IRR model, except that it operates on the assumption that the earnings will be reinvested at a selected constant rate of interest. It is not assumed that the cash flows can or will be reinvested at a rate equal to the Internal Rate of Return.

The investor is required to select a reasonable reinvestment rate and then assume that all future income will be reinvested at that rate. The AIRR is then computed by determining the interest rate that will equate the discounted positive and negative cash flows. Again, the required mathematical computations are best accomplished with the aid of a microcomputer.

A few observations can be made about the relationship existing among the various models of return on investment analysis. For each model, values are known or assigned to all but one component of the relevant equation. The value of the unknown item is then calculated. In the case of the Profitability Index the known items are the values of the inflows and outflows, as well as the desired interest rate chosen to discount those cash flows to their present value. The unknown item is the ratio of the discounted positive flow to the discounted negative flow. In computing the IRR and AIRR, values are also assigned to the projected cash inflows and outflows. The ratio of the discounted positive flow to the discounted negative flow is set at one. The unknown quantity is the precise interest rate necessary to achieve that equality.

This discussion of financial analysis has been brief, and many important points cannot be covered. It should be apparent, however, that two different investments that produce the same accounting rate of return will not necessarily be equally desirable. The pattern and timing of the projected cash flows can be of great importance. The discounted cash flow methods are generally the most reliable because they can effectively deal with the uneven nature of the cash flows. Regardless of which analytical model is selected, it should be applied to each investment alternative so that there will be a meaningful basis for comparison.

RATE OF RETURN

The Rate of Return Program will calculate the following:

1. The Net Present Value at n%
2. The Internal Rate of Return (IRR)
3. The Adjusted Internal Rate of Return (AIRR)

For input, the Program will request the following:

a. The investment amount
b. The discount rate to be used
c. The number of cash flows
d. The entry of each of the cash flows

The Program will allow the user to enter the flows in groups. For example, if you have 10 cash flows of $200 and 20 cash flows of $300, you need not enter 30 entries, but rather only two. It also allows the user to enter the number of times per year the cash flows are received. This is an advantage if the cash flows are received monthly rather than yearly.

The following examples are shown in the computer runs at the end of the program. The computer runs may look distorted if run on a printer, because they use CRT cursor controls, which have little meaning to a printer.

Example 1: An investor purchased an apartment complex for $100,000 by making a down payment of $20,000 and financing the remaining $80,000. The apartment was held for 10 years, during which time its value appreciated. Upon sale, the investor netted $80,000 (as indicated by No. 10 below). The cash flows realized in the interim years were as shown below. What was the rate of return on this investment?

1. $+ 200
2. $+ 400
3. $+ 600
4. $+ 2,000
5. $+ 4,000
6. $+ 5,000
7. $+ 5,000
8. $+ 5,000
9. $+ 6,000
10. $+80,000

Example 2: An investor purchased a mortgage that cost $30,000. It will generate income of $321.59 for 200 months, and then $300 for the next 100 months. What is the rate of return?

The program should work on any microcomputer using BASIC. The cursor controls are as follows:

TAB(-1, 0); clear screen
TAB(-1, 2); return to beginning of line
TAB(-1, 3); move cursor up one row
TAB(-1, 4); move cursor down one row

The Program will calculate the return by three separate methods, so the user may select the method that best suits the situation.☐

ABOUT THE AUTHOR

Tim Burke is vice president of The Basic Business Software Company, Incorporated, a software house. He has a B.S. degree from Notre Dame University and is involved in product development and distribution.

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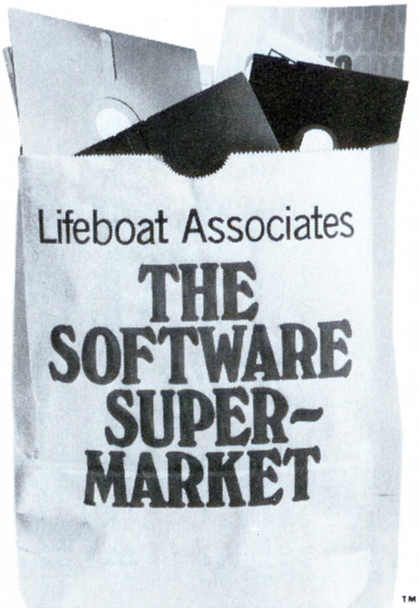

CIRCLE INQUIRY NO. 27

SAMPLE RUN 1

```
.RUN ROR                                    R.O.R.
                                            - - -
YOU MAY ENTER CASH FLOWS BY:
     (1)  INDIVIDUAL CASH FLOWS
     (2)  GROUPS OF EQUAL CASH FLOWS
PLEASE ENTER A (1) OR A (2) ? 2
-------------------------------------------------
ENTER THE AMOUNT OF THE INVESTMENT ? 30000
-------------------------------------------------
ENTER THE DISCOUNT RATE(%) ? 8.25
-------------------------------------------------
ENTER THE NUMBER OF GROUPS OF CASH FLOWS ? 2

                                    CASH FLOWS
                                    ---- -----

  PLEASE ENTER CASH FLOW NUMBER  1  ? 200

  PLEASE ENTER CASH FLOW NUMBER  2  ? 400

  PLEASE ENTER CASH FLOW NUMBER  3  ? 600

  PLEASE ENTER CASH FLOW NUMBER  4  ? 2000

  PLEASE ENTER CASH FLOW NUMBER  5  ? 4000

  PLEASE ENTER CASH FLOW NUMBER  6  ? 5000

  PLEASE ENTER CASH FLOW NUMBER  7  ? 5000

  PLEASE ENTER CASH FLOW NUMBER  8  ? 5500

  PLEASE ENTER CASH FLOW NUMBER  9  ? 6000

  PLEASE ENTER CASH FLOW NUMBER  10  ? 80000
```

```
--------------------------------------------------------------
HOW MANY TIMES ARE THE CASH FLOWS RECEIVED EACH YEAR ? 1

                                        CASH FLOWS
                                        ---- -----

              NUMBER          AMOUNT
              ------          ------

                1       $        200.00
                2       $        400.00
                3       $        600.00
                4       $      2,000.00
                5       $      4,000.00
                6       $      5,000.00
                7       $      5,000.00
                8       $      5,500.00
                9       $      6,000.00
               10       $     80,000.00

 ...............................................................
 ::                                                            ::
 ::                    RATES OF RETURN                         ::
 ::                       RESULTS                              ::
 ::------------------------------------------------------------::
 ::                                                            ::
 ::  THE INTERNAL RATE OF RETURN<IRR> =  21.24 %               ::
 ::                                                            ::
 ::------------------------------------------------------------::
 ::                                                            ::
 ::  THE ADJUSTED INTERNAL RATE OF RETURN<AIRR> =  19.52 %     ::
 ::                                                            ::
 ::------------------------------------------------------------::
 ::                                                            ::
 ::  THE NET PRESENT VALUE<NPV> AT 9.5 % INTEREST = $    28,048.07
 ::                                                            ::
 ::------------------------------------------------------------::
 ::                                                            ::
 ::  **<END OF PROGRAM>**                                      ::
 ::                                                            ::
 ::                                                            ::
 ...............................................................
```

SAMPLE RUN 2

```
.RUN ROR
                                          R.O.R.
                                          - - -
YOU MAY ENTER CASH FLOWS BY:
     (1)  INDIVIDUAL CASH FLOWS
     (2)  GROUPS OF EQUAL CASH FLOWS
PLEASE ENTER A (1) OR A (2) ? 1
-------------------------------------------------------------
ENTER THE AMOUNT OF THE INVESTMENT ? 20000
-------------------------------------------------------------
ENTER THE DISCOUNT RATE(%) ? 9.5
-------------------------------------------------------------
HOW MANY INDIVIDUAL CASH FLOWS ARE THERE ? 10

                                    CASH FLOWS
                                    ---- -----
CASH FLOW GROUP NUMBER  1 :    ENTER CASH FLOW ? 321.59
                               NUMBER OF CASH FLOWS ? 200

CASH FLOW GROUP NUMBER  2 :    ENTER CASH FLOW ? 300
                               NUMBER OF CASH FLOWS ? 100

-------------------------------------------------------------
HOW MANY TIMES ARE THE CASH FLOWS RECEIVED EACH YEAR ? 12
                                    CASH FLOWS
                                    ---- -----
         NUMBER    NUMBER OF CASH FLOWS       AMOUNT
         ------    ------ -- ---- -----       ------

            1             200           $       321.59
            2             100           $       300.00

..........................................................
::                    RATES OF RETURN                   ::
::                        RESULTS                       ::
::------------------------------------------------------::
::                                                      ::
::  THE INTERNAL RATE OF RETURN<IRR> =  12.17 %         ::
::                                                      ::
::------------------------------------------------------::
::                                                      ::
::  THE ADJUSTED INTERNAL RATE OF RETURN<AIRR> =  9.45 % ::
::                                                      ::
::------------------------------------------------------::
::                                                      ::
::  THE NET PRESENT VALUE<NPV> AT 8.25 % INTEREST = $    10,391.94
::                                                      ::
::------------------------------------------------------::
::                                                      ::
::  **<END OF PROGRAM>**                                ::
::                                                      ::
..........................................................
```

PROGRAM LISTING

```
10 REM THIS PROGRAM WAS WRITTEN BY:
20 REM TIMOTHY J. BURKE
30 REM THE BASIC BUSINESS SOFTWARE COMPANY
40 REM POST OFFICE BOX 2032
50 REM SALT LAKE CITY, UTAH  84110
60 REM (801) 363-1199
70 REM COPYRIGHT NOVEMBER 1, 1978 - ALL RIGHTS RESERVED
100 REM     <ROR>     <ALPHA BASIC 3.4><VERSION 3.1>      <11/01/78>
110 DIM X(400),A(30),B(30)
120 SIGNIFICANCE 10
130 STRSIZ 30
140 C$="$###,###,###.##"
150 PRINT TAB(-1,0)
160 PRINT TAB(37);"R.O.R."
170 PRINT  TAB (37);"- - -"
180 PRINT
190 PRINT
```

```
810 NEXT I
820 X4=2.5
830 GOTO 1370
840 GOSUB 1720
850 PRINT "ENTER THE NUMBER OF GROUPS OF CASH FLOWS ";
860 INPUT C1
870 PRINT
880 PRINT TAB(-1,0)
890 PRINT
900 PRINT  TAB (36);"CASH FLOWS"
910 PRINT  TAB (36);"---- -----"
920 PRINT
930 PRINT
940 FOR I=1 TO C1
950 PRINT"CASH FLOW GROUP NUMBER ";I;":   ENTER CASH FLOW ";
960 INPUT A(I)
970 PRINT"                                  NUMBER OF CASH FLOWS ";
980 INPUT B(I)
990 PRINT
1000 NEXT I
1010 GOSUB 1720
1020 PRINT "HOW MANY TIMES ARE THE CASH FLOWS RECEIVED EACH YEAR ";
1030 INPUT P1
1040 PRINT TAB(-1,0)
1050 PRINT
1060 PRINT  TAB (36);"CASH FLOWS "
1070 PRINT  TAB (36);"---- -----"
1080 FOR I=1 TO C1
1090 FOR J=1 TO B(I)
1100 X1=X1+1
1110 X(X1)=A(I)
1120 NEXT J
1130 NEXT I
1140 PRINT
1150 PRINT
1160 PRINT TAB(10);"NUMBER";TAB(20);"NUMBER OF CASH FLOWS";
1170 PRINT TAB(48);"AMOUNT"
1180 PRINT TAB(10);"------";TAB(20);"------ -- ---- -----";
1190 PRINT TAB(48);"------"
1200 PRINT
1210 FOR I=1 TO C1
1220 PRINT TAB(13);I;TAB(27);B(I);TAB(42);
1230 PRINT USING C$;A(I)
1240 NEXT I
1250 PRINT
1260 PRINT
1270 PRINT
1280 I5=.139
1290 D8=1E-02
1300 P9=0
1310 P=0
1320 FOR I=1 TO C1
1330 P8=((1-(1+I5/P1)^(-B(I)))/(I5/P1))*A(I)
1340 P=P+P8*(1+I5/P1)^(-P9)
1350 P9=P9+B(I)
1360 NEXT I
1370 N5=X5-P
1380 IF N5<-1E-04*X5 THEN 1410
1390 IF N5>1E-04*X5 THEN 1500
1400 GOTO 1580
```

```
200 PRINT "YOU MAY ENTER CASH FLOWS BY:"
210 PRINT
220 PRINT "      (1)  INDIVIDUAL CASH FLOWS"
230 PRINT "      (2)  GROUPS OF EQUAL CASH FLOWS"
240 PRINT
250 PRINT"PLEASE ENTER A (1) OR A (2) ";
260 INPUT N1
270 IF N1<>1 AND N1<>2 THEN 150
280 PRINT
290 GOSUB  1720
300 PRINT "ENTER THE AMOUNT OF THE INVESTMENT ";
310 INPUT X5
320 PRINT
330 GOSUB 1720
340 PRINT "ENTER THE DISCOUNT RATE(%) ";
350 INPUT D5
360 PRINT
370 GOSUB 1720
380 D5=D5/100
390 IF N1=2 GOTO 850
400 PRINT "HOW MANY INDIVIDUAL CASH FLOWS ARE THERE ";
410 INPUT C1
420 PRINT
430 X1=C1
440 PRINT TAB(-1,0)
450 PRINT
460 PRINT  TAB (36);"CASH FLOWS"
470 PRINT  TAB (36);"---- -----"
480 PRINT
490 PRINT
500 FOR I=1 TO C1
510 PRINT "PLEASE ENTER CASH FLOW NUMBER ";I;" ";
520 INPUT X(I)
530 PRINT
540 NEXT I
550 GOSUB  1720
560 FOR I=1 TO C1
570 PRINT "HOW MANY TIMES ARE THE CASH FLOWS RECEIVED EACH YEAR ";
580 INPUT P1
590 PRINT
600 PRINT TAB(-1,0)
610 PRINT
620 PRINT  TAB (36);"CASH FLOWS"
630 PRINT  TAB (36);"---- -----"
640 PRINT
650 PRINT
660 PRINT  TAB (10);"NUMBER"; TAB (25);"AMOUNT"
670 PRINT  TAB (10);"------"; TAB (25);"------"
680 PRINT
690 FOR I=1 TO C1
700 PRINT TAB(13);I;TAB(21);
710 PRINT USING C$;X(I)
720 NEXT I
730 PRINT
740 PRINT
750 PRINT
760 I5=.139
770 D8=.139
780 P=0
790 FOR I=1 TO C1
800 P=P+X(I)*(1+I5/P1)^(-I)
```

```
1410 REM
1420 REM
1430 D8=I5*((P-X5)/X5)
1440 REM
1450 I5=I5+D8
1460 IF I5<>0 THEN 1480
1470 I5=1E-02
1480 IF X4=2.5 THEN 780
1490 GOTO  1300
1500 REM
1510 REM
1520 D8=I5*((P-X5)/X5)
1530 REM
1540 I5=I5+D8
1550 IF I5<>0 THEN 1570
1560 I5=1E-02
1570 GOTO  1480
1580 FOR I=1 TO X1
1600 REM
1610 F1=F1+X(I)*(1+D5/P1)^(X1-I)
1640 NEXT I
1650 A5=((F1/(P2+X5))^(1/X1)-1)*100*P1
1660 FOR I=1 TO X1
1670 P7=P7+X(I)*(1+D5/P1)^(-I)
1680 NEXT I
1690 N5=P7-X5
1700 GOTO 1730
1710 GOSUB  1720
1720 FOR I=1 TO 80 : PRINT"-"; : NEXT I : PRINT : RETURN
1730 D5=D5*100
1740 PRINT TAB(-1,0)
1750 FOR I=1 TO 79 : PRINT"*"; : NEXT I
1760 PRINT TAB(-1,2);TAB(-1,4);
1770 FOR I=1 TO 21 : PRINT"**";TAB(77);"**" : NEXT I
1780 FOR I=1 TO 79 : PRINT"*"; : NEXT I
1790 PRINT TAB(-1,1);TAB(-1,4);TAB(-1,4);
1800 PRINT TAB(30);"RATES OF RETURN";TAB(-1,2);TAB(-1,4);
1810 PRINT TAB(30);"   RESULTS";
1820 PRINT TAB(-1,2);TAB(-1,4);
1830 PRINT TAB(2); : FOR I=1 TO 75 : PRINT"="; : NEXT I
1840 PRINT TAB(-1,2);TAB(-1,4);TAB(-1,4);
1850 PRINT TAB(5);"THE INTERNAL RATE OF RETURN<IRR> = ";
                                       INT(I5*10000+.5)/100;
1860 PRINT"%";
1870 PRINT TAB(-1,2);TAB(-1,4);TAB(-1,4);
1880 PRINT TAB(2); : FOR I=1 TO 75 : PRINT"-"; : NEXT I
1890 PRINT TAB(-1,2);TAB(-1,4);TAB(-1,4);
1900 PRINT TAB(5);"THE ADJUSTED INTERNAL RATE OF RETURN<AIRR> = ";
1910 PRINT INT(A5*100+.5)/100;"%";
1920 PRINT TAB(-1,2);TAB(-1,4);TAB(-1,4);
1930 PRINT TAB(2); : FOR I=1 TO 75 : PRINT"-"; : NEXT I
1940 PRINT TAB(-1,2);TAB(-1,4);TAB(-1,4);
1950 PRINT TAB(5);"THE NET PRESENT VALUE<NPV> AT";D5;"% INTEREST = ";
1960 PRINT USING C$;N5;
1970 PRINT TAB(-1,2);TAB(-1,4);
1980 PRINT TAB(-1,2);TAB(-1,4); : PRINT TAB(2);
1990 FOR I=1 TO 75 : PRINT"-"; : NEXT I
2000 PRINT TAB(-1,2);TAB(-1,4);TAB(-1,4);TAB(5);"**<END OF PROGRAM>**";
2010 PRINT TAB(-1,2);TAB(-1,4);
2020 FOR I=1 TO 5 : PRINT TAB(-1,4); : NEXT I
2030 END
```

WORD PROCESSING IN BASIC

A TRS-80 Letterwriter

By C. L. Cooper, M.D.

The medicine wagon rumbles into town and even before Doctor Stoutheart steps out the back onto his platform you can read the beautiful advertisement on the side of the wagon. You can tell immediately that his bottled Elixir of Ambrosia is for you; at least you want to believe, for you have the problems for which the advertisement proclaims a cure. Dr. Stoutheart begins his presentation and by now a small crowd has joined you at the back of the wagon, including a young boy who is later told to leave because he asks to try the elixir before buying it.

In many ways, software advertisements are filled with Doctor Stouthearts, offering promises without allowing the buyers to sample the merchandise. After a visit to the small business microcomputer show in Pasadena last year I knew that just around the corner the answer to all of my business record keeping problems was about to emerge. Unfortunately, this has not happened. The programs necessary for the thousands of varied small businesses around the country will not emerge in a final form, but they will be developed a concept at a time and will go through an evolution of modifications before becoming usable.

Many of the present programs being offered by the software producers are falling short of expectations because of at least one major fault. The majority of the programs are like the elixirs of the past, offered without modification being readily available and with a "buy it all or none of it" sales approach.

A more realistic approach would be to offer a small portion of the program for an introductory price. If the partial program works out in an office on available equipment, with only minor alterations, the businessman would be in a position to purchase the remaining portions of the program or revision updates for his particular needs. The programs should be offered in a common language that can easily be modified by local people familiar with individual office needs.

It is with this in mind that I am presenting an example of how I believe the business programs should be offered. The program is a simple text writer used for letter writing in my office, written for the TRS-80.

When I first started my private practice I used computer billing through a large, well organized bank. But after a few years the increasing price made the program prohibitive. I switched to a service bureau computer billing program, but that did not work well. Attempting to find a reliable method, I attended the microcomputer convention in Pasadena and I was overwhelmed with what was "soon to be available." I purchased a TRS-80 and began a self education program.

The simplest program with which to work seemed to be word processing. This would solve many typing problems and make it easy to correct errors. But it didn't work out the way I had planned. I began to receive a mini-course in what was yet to come with the larger programs and more sophisticated hardware systems.

I purchased a word processor program along with a small interface to print the output on my modified Selectric typewriter. At the end of the week my secretary was in tears and my correspondence was a week behind. The program was hidden in machine language and there was no way to modify it to our needs. The text had to be saved and loaded on tape. It took the operator longer to process the typed text than it did for her to retype a corrected version from the beginning. I am not complaining that I was misled, for the ad clearly stated that it would be stored on cassette.

In sharp contrast, at the time I purchased the above program I also purchased from the same company a small interface output device. In order for the hardware interface to work, a small software program, written in BASIC, had to be loaded prior to the main program. Because they had written the program in BASIC there was no problem modifying the program to meet our needs and actually incorporating it into a program such as the one being presented. But the word processor is sitting unused until we can trade it in on an improved version. Before I purchase any large business programs it is going to be necessary for the provider to demonstrate the adaptability of his program to my needs.

LETTERWRITER

The LETTERWRITER as listed for this article is written for the TRS-80 with disk BASIC. It will work moderately well with only 16K of memory, however I recommend 32K. The primary limiting factor is the size of the sequential file that can be loaded for editing with the editor in BASIC. If hyphen-syllable, right justification, or page title and number routines are to be added, then 32K of memory becomes even more desirable.

The program works very well with a TRS-80; more expensive equipment is not really necessary. My CPU KEYBOARD UNIT has not been modified for upper and lower case display; however, it has not been much of a problem in that I proofread from the Selectric typewriter printout. As the program progresses, it makes use of the TRS-80's large print for instructions and small print for entering the text.

After a brief introduction the menu sends the user off to one of two routines or turns back to BASIC for editing with the text file already loaded for line-by-line editing. The text creation routine makes use of the line input statement for the creation of a series of strings that can be entered without regard for punctuation or quotation marks.

In order for the lines to be kept a reasonable length during the hardcopy routine, an ENTER is hit at the end of each screen line on the CRT. If it runs over a little, there is no problem. Just finish the word and then hit ENTER. As the strings are recorded on the disk a sequential line number and remark statement are added for use in editing. A short tab space routine is available for the first line of a paragraph or for an individual line entry. This is accomplished by typing in an upward pointing arrow followed by a delineater number. The routine creates a space string as long as the listed delineater; this then precedes the entered line input string.

At the end of a single line entry (date, address, salutation, etc.) or at the end of a paragraph an "#" is typed in for a code to be used by the printout routine. At the end of the text creation an "@" is typed in as a printout code and as a signal to the program that the text creation has come to an end for the time being.

The other available routine is the printout; this will be explained later with the listing description. It is possible to have the printout with or without line numbers; the line numbers facilitate editing by hard copy.

LINE NUMBER EXPLANATIONS

Line 30
The letters A-Z are defined as integers and the beginning line number (L#) is set at 1000 (actually the HEADER will have the number 1000 and the first TEXT line number will be 1010). The CLEAR statement of 1000 can be reduced if less memory is used.

Lines 40-120
The MENU is listed and the program is directed to the correct portion of the text processing routine.

Lines 3000-3060
A file is opened after first checking to see if there is already a file present by the same name by use of ERROR CODES.

Lines 3070-3080
The HEADER is created, assigned the first line number and then recorded as the first entry on the newly created sequential file.

Line 3110
The input is generated with LINE INPUT statements so the strings can be entered without regard for commas or quotation marks.

Lines 3120-3125
This is a space string routine that is created by using the STRING$ function of the TRS-80 whereby a string of blank spaces can be created as well as a string of any other character. This function is also used later in the program for blank line creation when more than one LINE FEED is desired. The "[" in the listing is an upward arrow on the keyboard.

Lines 3130-3180
I almost didn't include this routine in the "introductory" listing, however, it makes the program run much better. This is a string dividing technique that lets you type in your program any way you please as long as you occasionally hit an ENTER after either completing a word or a sentence. If you forget and go for a full 255 characters without hitting ENTER, you will have to stop, back up and hit ENTER after the last completed word or sentence. Without the string dividing routine the lines for numbered hard copy have a tendency to be too long if you forget to hit ENTER at the end of each line.

Line 3190
This records the lines that are less than 65 characters long. Both of the above routines will add a line number and a REMARK abbreviation prior to recording the string in the file. The line numbers are used for editing the hard copy and for line manipulation within the program.

Line 3200
Closes the file and gives you a chance to request a hard copy printout.

Lines 3210-3260
The print out at this point can be with or without numbers. If you do not want line numbers listed it gives you a sample copy of the final printout routine. "Z=1" is a code to the print routine designating a return to EDIT when the hard copy is complete. "LS" is the double space code. "L" is the cumulative variable that stops the printout with line numbers when it is time to change the sheet of paper in your typewriter. Because the strings are continuously being recorded in the file, you are never working with a large string number, thus less memory is required.

Lines 4000-4110
The final editing will have to be done in the BASIC EDITOR of your equipment, however, a printout routine and a reminder that the edited file must be re-entered with an ASCII SAVE statement at the completion of the editing is included.

Line 5030
"LL"=line length control
"PL"=page length control
"X"=cumulative line printings code
"T"=title and page numbering control
"LS"=double space code

Lines 5040-5050
Opens the desired file and gives you the first string recorded, from which it removes the line number, REMARK statement and prints it on the screen as the HEADER.

Line 5120
Begins the series of strings that will make up the TEXT.

Line 5130
Blank line printout routine.

Line 5140
Removes the line numbers and the REMARK statement from the strings.

Line 5160
Adds a SHORT STRING or a REMAINDER STRING previously received to the beginning of the latest string from the file. They are then handled as a single string.

Lines 5200-5295
A line or string that is shorter than the line length plus one is examined to see if it should be printed as a last line in a paragraph, the last line in the text, or as an entire line if it happens to be the exact line length. If not, it is converted to a remainder string and sent back with a trailing space to precede the incoming string from the file.

Lines 5340-5430
A string longer than the line length is divided at the first space shorter than the line length plus one. The trailing blank is removed and the remainder becomes the REMAINDER STRING. The leading blanks are removed from the REMAINDER STRING. If the hyphen routine is to be used the leading blanks should be maintained temporarily.

Lines 5540-7000
Once the LINE STRING for printing is defined, it is printed and the number of lines printed is compared to the page length. If the number is sufficient, the program is stopped while the paper is changed in the typewriter.☐

SAMPLE RUN

```
I44
                                        DATE#
NAME#
ADDRESS#
STATE#

Dear Sir,#
I5
     This is a sample of how your screen would look during a
typical letter writing exercise.  Where this letter shows a
capital "I44" for the space command the screen would actually
show an upward arrow with 44 immediately following it.#

I5
     I can't actually show the upward arrow because it is a
command code and it will not print out on the screen as letter
text.  The final paragraph.#

I44
                                        Respectfully,#

I44
                                        C. L. Cooper, M.D.@
```

PROGRAM LISTING

```
10 '* * * * * * LETTERWRITER BY C. L. COOPER   1978 * * * * * *

20 'LINE #1000-2900 LEFT BLANK FOR SERIAL PRINTER ROUTINE
   SUCH AS THE TRS232 SMALL SYSTEMS ROUTINE IN BASIC

30 DEFINT A-Z:CLEAR1000:L#=1000:CLS

40 PRINT CHR$(23):PRINT"* * LETTERWRITER TEXT CREATION * *"

50 PRINT"ENTER TODAY'S DATE (MM/DD/YY) ?"
   :INPUT D8$ :PRINT:PRINT :IF LEN(D8$)<>8 GOTO 50

60 PRINT CHR$(23):PRINT"* * TEXT CREATION PROGRAM * *"
   :PRINT"THE FUNCTIONS AVAILABLE ARE:":PRINT

70 PRINT"1. - BUILD A TEXT OR LETTER":PRINT
   :PRINT"2. - EDIT A PREVIOUSLY PREPARED       TEXT"
   :PRINT"  (EDITOR IN BASIC WILL BE USED)":PRINT
   :PRINT"3. - PRINT COPY OF A PREVIOUSLY       PREPARED TEXT"
   :PRINT

110 INPUT"WHICH WOULD YOU LIKE TO DO";Q3:IFQ3<1 OR Q3>3 THEN 70

3215 INPUT"?DOUBLE SPACE (Y OR N)";Q$ :IF Q$="Y"THEN LS=2

3220 CLS:PRINT CHR$(23):PRINT"* * TURN ON PRINTER * *":PRINT
     :INPUT"HIT ENTER WHEN READY";XZ$:L=0

3230 IF EOF(1) THEN CLOSE1:CLS:RETURN

3240 LINEINPUT#1,A$:LPRINTA$:L=L+1:IFLS=2THENLPRINT" ":L=L+1

3250 IF L>50 INPUT"CHANGE PAPER - HIT ENTER TO CONT";XZ$:L=0

3260 GOTO3230

4000 '* * * * CREATION TEXT EDIT ROUTINE * * * * * * * * * * * *

4010 CLS:PRINT CHR$(23):PRINT"EDIT ROUTINE - - IN BASIC'EDITOR"

4020 PRINT:PRINT"WHEN THROUGH EDITING YOU MUST"
     :PRINT"SAVE THE EDITED PROGRAM WITH"
     :PRINT"THE ASC II COMMAND":PRINT
     :PRINT TAB(8)"SAVE";CHR$(34);"FILENAME";CHR$(34);",A"

4030 PRINT:INPUT"HIT ENTER TO CONTINUE";XZ$:CLS

4040 INPUT"TYPE DESIRED TEXT FILENAME FOR EDIT AND HIT ENTER";F7$

4045 INPUT"WOULD YOU LIKE A HARD COPY OF FILE PRIOR TO EDIT";Q$
     :IFQ$<>"N"GOSUB3210

4050 ' * * * CRT REVIEW ROUTINE STARTS HERE IF DESIRED

4100 CLS:PRINTCHR$(23):PRINTF7$:PRINT"WHEN READY TO RETURN TO";
     " BASIC":PRINT"FOR EDITING THE ABOVE FILE HIT  ENTER"
     :PRINT:PRINT"REMEMBER TO SAVE IN ASC II "
     :PRINT"AFTER EDITING"

4110 INPUT"AFTER FILE LOADS TYPE 'EDIT #' TO BEGIN  EDIT";ZX$
     :LOAD F7$

5000 '* * * * PRINTER ROUTINE * * * * * * * * * * * * * * * * *

5030 CLOSE1:LL=72:PL=44:X=0:Z=0:T=0:LS=1:CLS

5040 PRINT CHR$(23):PRINT"* * PRINTER ROUTINE * *"
     :INPUT"ENTER FILENAME";F7$:OPEN"I",1,F7$

5050 LINEINPUT#1,A$:PRINTMID$(A$,INSTR(A$,"'"))

5060 INPUT"LINE LENGTH 30-90";LL:INPUT"PAGE LENGTH 3-55";PL
    :INPUT"? DOUBLE SPACE (Y OR N)";Q$:IFLEFT$(Q$,1)="Y"THENLS=2

5070 IF LL<30 OR LL>90 THEN 5060

5080 IF PL<3 OR PL>55 THEN 5060

5090 INPUT"HIT ENTER WHEN READY TO PRINT";XZ$
     :PRINT"* * TEXT PRINTING * *"

5100 IF EOF(1)THEN CLOSE1:CLS:IFZ=1 GOTO 4100 ELSE 60
```

```
120 ON Q3 GOTO 3000,4000,5000

1000 'BASIC PROGRAM FOR INITIALIZING TRS232 PRINTER INTERFACE

3000 '* * * * TEXT CREATION * * * * * * * * * * * * * * * * * * *

3010 CLS:PRINT TAB(16)"* * TEXT CREATION * *":PRINT

3020 INPUT"TYPE A TEXT FILE NAME";F7$
     :IFLEN(F7$)<1ORLEN(F7$)>7THENPRINT"LIMIT TO 7 CHARACTERS!"
     :GOTO 3020

3030 IF ERR/2+1=54 GOTO 3060

3040 ON ERROR GOTO 3030

3050 OPEN "I",1,F7$:CLOSE
     :PRINT"FILE ALREADY EXISTS BY THAT NAME":GOTO 3020

3060 OPEN "O",1,F7$

3070 A$=STR$(L#)+"' "+"FILENAME * "+F7$+"  CREATION DATE: "+D8$

3080 PRINT#1,A$:L#=L#+10:PRINT"HEADER WILL READ ** ";
     MID$(A$,INSTR(A$,"'")+2):PRINT
3100 PRINT"= = = BEGIN TEXT ENTRY = = ="

3110 LINEINPUT A$

3120 IF LEFT$(A$,1)="[" THEN SP=VAL(MID$(A$,2))
     :IF SP>1 AND SP<64 THEN S$=STRING$(SP," ")
     :PRINT S$;:LINEINPUT A$:A$=S$+A$

3125 IF LEFT$(A$,1)="[" AND SP<2 OR SP>63 PRINT
     "INCORRECT DELINEATER":GOTO3110

3130 IF LEN(A$)<65 THEN 3190

3140 FOR I=65 TO 10 STEP -1

3150 IF MID$(A$,I,1)=" "GOTO 3160

3155 NEXT

3160 T$=LEFT$(A$,I) :A$=MID$(A$,I+1)

3180 T$=STR$(L#)+"' "+T$ :PRINT #1,T$ :L#=L#+10 :GOTO 3130

3190 A$=STR$(L#)+"' "+A$ :PRINT #1,A$ :L#=L#+10
      :IF RIGHT$(A$,1)="@"THEN  3200 ELSE 3110

3200 CLOSE1:PRINT"ENDING TEXT CREATION":PRINT
     :INPUT"WOULD YOU LIKE HARDCOPY LISTING OF YOUR TEXT";Q$
     :IF LEFT$(Q$,1)<>"Y"THEN60 ELSE GOSUB3210

3205 GOTO60

3210 OPEN"I",1,F7$:PRINT
     :INPUT"DO YOU WANT LINE NUMBERS LISTED";Q1$
     :IF LEFT$(Q1$,1)<>"Y"THENZ=1:LS=1:GOTO5050
```

```
5120 LINEINPUT#1,A$

5130 IF LEN(A$)<8 THEN LPRINT" ":X=X+1
     :IFX>PL-2 GOSUB 7000 ELSE 5100

5140 A$=MID$(A$,INSTR(A$,"'")+2)

5160 IF LEN(B$)>0 THEN A$=B$+A$:B$=""

5180 LA=LEN(A$):IF LA<=LL+1 THEN 5200 ELSE 5300

5200 '* * SHORT LINE ROUTINE FOR PARAGRAPH AND END CHECK * *

5210 IF RIGHT$(A$,1)="#" THEN A$=LEFT$(A$,LA-1)
     :LPRINT A$:A$="":X=X+1:IFLS=2 THEN LPRINT" ":X=X+1

5240 IF RIGHT$(A$,1)="@"THEN A$=LEFT$(A$,LA-1)
     :LPRINT A$:A$="":CLS:CLOSE1:IFZ=1 GOTO 4100 ELSE 60

5260 IF LA=LL AND RIGHT$(A$,1)<>"#" AND RIGHT$(A$,1)<>"@"THEN
     LPRINT A$:A$="":X=X+1:IF LS=2 THEN LPRINT" ":X=X+1

5280 IFX>=PL GOSUB 7000

5290 IFLEN(A$)>0THENB$=A$:A$="":IFRIGHT$(B$,1)<>" "THENB$=B$+" "

5295 GOTO 5100

5300 '* LONG LINE ROUTINE FOR DIVIDING A$ INTO L$ AND B$ *

5320 IF LL>=LA THEN 5180

5340 FOR I=LL+1 TO 5 STEP-1

5360 IF MID$(A$,I,1)=" "AND MID$(A$,I-1,1)<>" "GOTO5400

5380 NEXT

5400 L$=LEFT$(A$,I-1):B$=MID$(A$,I+1):A$="":N=LEN(L$)

5430 IF LEFT$(B$,1)=" "THEN B$=MID$(B$,2):GOTO 5430

5440 ' * * * SYLLABLE GOSUB IF LL-N > 5

5450 ' * * * RIGHT JUSTIFICATION GOSUB IF DESIRED
5500 '* PRINT ROUTINE *

5540 LPRINT L$:L$="":X=X+1:IF LS=2 THEN LPRINT" ":X=X+1

5550 IF X>=PL GOSUB 7000

5560 GOTO 5160

7000 PRINT CHR$(23):PRINT:PRINT"CHANGE SHEET OF PAPER"
     :INPUT"TYPE IN NEW PAGE LENGTH IF      CHANGE NEEDED";PL
     :INPUT"HIT ENTER TO CONTINUE";XZ$:X=0:CLS
     :RETURN

7010 ' * * * TITLE PAGE NUMBER ROUTINE * * * * * * * * * * *
```

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CIRCLE INQUIRY NO. 41

TWO VIEWS

By Jim Schreier, Associate Editor

Any red-blooded business can be judged by how much is taken in and how much is spent and how much is left over. The purpose of this article is to examine some profit potential on what is taken in and how much is spent. Two very short programs can be run on a microcomputer, answering questions often asked but very time consuming to hand calculate. These programs are the cost of riding payables on one hand and the effectiveness of receivable collections on the other.

The federal government says trade receivables have grown 243% between 1955 and 1977. This may be caused by an expanding credit economy. However, during the same period of time, bad debt losses have increased seven times. Many businessmen believe stretching out their payables may provide a very cheap source of business capital. The question is, then, how much can you save by riding the payables and skipping the discounts?

A DISCOUNT

Let's say a company has a new shipment of floppy disks for its computer and the terms are 2%/10 net 30. This may be translated to: If the invoice is paid within 10 days of shipment there is a 2% cash discount. If, however, you wait until the 11th day you surrender the discount and the invoice becomes payable in full and will be judged delinquent 30 days from shipment. But if you pass up the discount, what will it cost?

The BASIC program "Accounts Payable Discount" (Figure 1), uses the following formula:

$$C=(P/(F-P)*Y/L)*(100)$$

In this formula C is the cost of failing to discount, P is the percentage of allowable discount, L is the difference of the allowed discount date and the due date, F is the constant, 100, and Y is the banker's year, 360 days.

Since the disks have the terms 2%/10 net 30 the formula has the following figures: $C=2/98 * 360/20$ or $.0204 * 18$. This gives 36.72%. In other words failing to take the 2% discount costs over 36% annually based on annual rate comparisons.

COLLECTIONS

Taking the payable discounts is not the only way to get ahead with credit. One tool to discover the effectiveness of collections is the average collection period. This program, Figure 2, needs a small base, your most recent 12 months credit sales. These figures may be entered month-by-month from the program prompts found starting in line 1030.

The formula for the average collection period is:

$$A=0*B/T$$

In this case A would be the average days of outstanding credit sales, 0 is the outstanding accounts receivable, B is the number of business days in the year, here set at 300; and T is the most recent 12 month credit sales. The result of this calculation will be in days. If your terms are net 30 and your average collection period is 75 days, your work is cut out for you!

Both programs are written in standard 8K BASIC supporting more than one statement per line. If your BASIC does not allow this feature, simply enter each statement on a separate line. A 4K BASIC may be used by removing the string references for program re-calculation.

The PRINT CHR$(26) and CHR$(2) statements are used to clear the CRT. They may be left out if not needed.

A microcomputer allows key information about businesses from a number of sources. These two short programs may be helpful tools in management decisions.☐

OF CREDIT

```
0010 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
0020 LINE= 120:DIGITS=2
0030 PRINT :PRINT
0050 PRINT TAB(15);"ACCOUNTS PAYABLE DISCOUNTS"
0055 PRINT TAB(20);"BY JIM SCHREIER"
0060 PRINT :FORX9=1TO54:PRINT"*"; :NEXTX9:PRINT
0070 PRINT
0100 PRINT TAB(5);"THIS PROGRAM CACULATES THE EFFECTIVE COST OF"
0110 PRINT TAB(5);"NOT  TAKING THE ALLOWABLE  DISCOUNTS ON YOUR"
0120 PRINT TAB(5);"ACCOUNTS PAYABLE. "
0130 PRINT
0140 PRINT TAB(5);"THE PRATICE OF RIDING THE PAYABLES MAY BE  A"
0150 PRINT TAB(5);"COST WHICH YOU MAY BE INTERESTED IN CONVERT-"
0160 PRINT TAB(5);"ING INTO PROFIT. "
0170 PRINT :INPUT"HIT [ RETURN ] TO CONTINUE. ",X$
0180 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
0500 PRINT :PRINTTAB(9);"EXAMPLE: 2% / 10 NET 30 TERMS"
0505 FOR X9=1TO29:PRINTTAB(9);"-"; :NEXTX9:PRINT:PRINT
0510 PRINT TAB(5);"THIS EXAMPLE READS THAT A 2% DISCOUNT"
0520 PRINT TAB(5);"MAY BE TAKEN IF PAID IN 10 DAYS.   IF"
0530 PRINT TAB(5);"THE DISCOUNT  IS MISSED THEN THE  NET"
0540 PRINT TAB(5);"BECOMES DUE IN FULL IN 30 DAYS. ":PRINT
0550 PRINT :INPUT"PLEASE HIT [ RETURN ] TO CONTINUE. ",X$
0560 GOTO 1100
0900 INPUT "ENTER % DISCOUNT ALLOWED ",P
0910 INPUT "ENTER ALLOWED DISCOUNT DATE ",B
0920 INPUT "ENTER NET DUE DATE ",D
0950 LET L=D-B:F=100:Y=360
0960 LET C=(P/(F-P)*Y/L)*(100)
0965 PRINT :PRINT
0970 PRINT :PRINTTAB(5);"BY NOT DISCOUNTING YOU ARE PAYING"
0980 PRINT TAB(5);"THE RATE OF ";C;"% PER YEAR."
0990 PRINT
1000 PRINT :INPUT"DO YOU WISH TO RECACULATE, [ Y ] OR [ N ]",X$
1010 IF X$<>"N" THEN GOTO 1100
1020 END
1100 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
1110 GOTO 900
```

PROGRAM 1

```
0100 GOSUB 5000:DIGITS=2:LINE=120:PRINT
0110 PRINT TAB(18);"AVERAGE COLLECTION PERIOD"
0115 PRINT TAB(23);"BY JIM SCHREIER":PRINT
0120 FOR X9=1TO64:PRINT"-"; :NEXTX9:PRINT
0130 GOTO 1005
0150 LET A=0:O=0:T=0:G=0
1000 GOSUB 5000:PRINT:PRINT
1005 PRINT
1010 PRINT TAB(9);"ENTER THE LAST TWELVE MONTHS' CREDIT"
1011 PRINT TAB(16);"SALES MONTH-BY-MONTH:"
1030 DIGITS= 0:PRINT:FOR X9=1TO12
1040 LET G=G+1
1050 PRINT TAB(5);"CREDIT SALES FOR MONTH #";G; :INPUTT1
1060 LET T=T+T1
1070 NEXT X9
1080 PRINT TAB(5);"YEAR-TO-DATE CREDIT SALES = $ ";T
1085 PRINT :PRINT
1090 INPUT "ENTER OUTSTANDING ACCOUNTS RECEIVABLE",O
1095 PRINT
2000 INPUT "PLEASE HIT [ RETURN ] TO CONTINUE",X$:GOSUB5000
2010 DIGITS= 2:B=300
2020 LET A=O*B/T
2040 PRINT :PRINT
2050 PRINT TAB(5);"AVERAGE DAYS' OUTSTANDING CREDIT IS ";A;"DAYS"
2060 PRINT TAB(5);"AVERAGE DAILY CREDIT SALE = $ ";T/B
3000 PRINT :PRINT
3010 INPUT "MORE DATA TO CACULATE, [ Y ] OR [ N ]",X$
3020 IF X$<>"N" THEN 150
3030 END
5000 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
5010 RETURN
```

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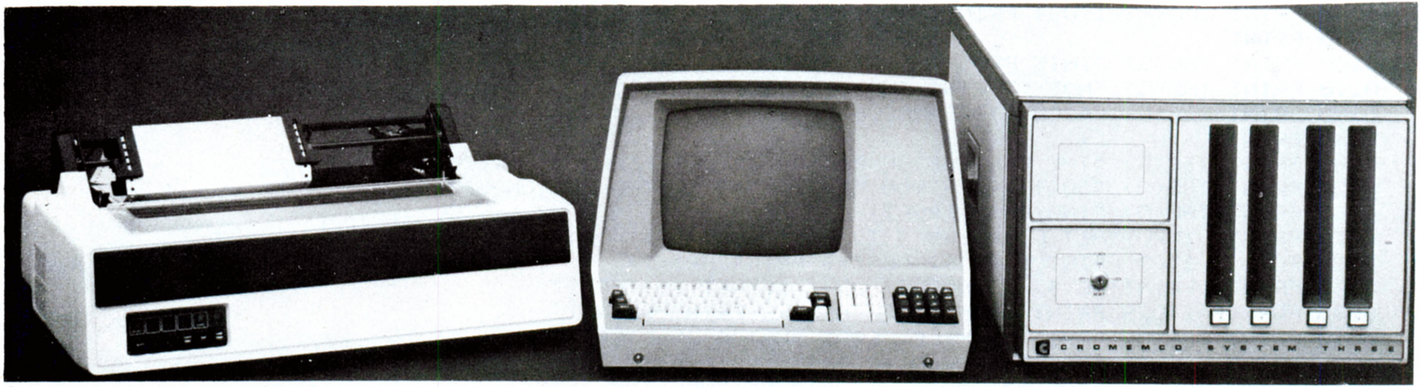

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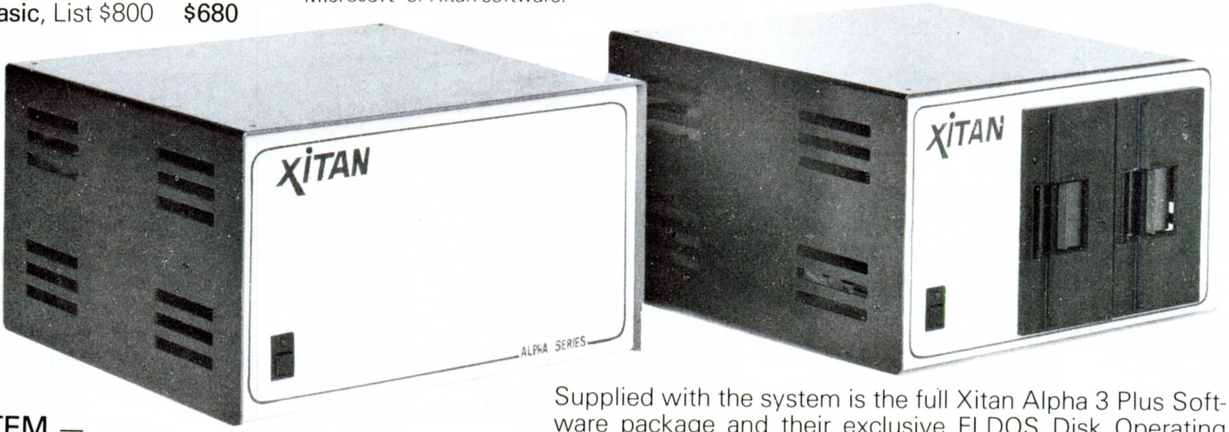

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NAMELIST: A Formatted Name Listing Routine

By Ron Tipton

One of the most common business needs is that of printing lists of customers, clients or patients. Most often, names are entered and stored as fixed length fields. Commonly used lengths are 15 characters for the last name, a 10-character first name and a middle initial. These are usually long enough for a single name in each field, but the fields should be long enough for their intended use.

Assume that 15, 10 and 1 fit the requirement. Whether sequential data files are read form tape or disk or even a keyed file, the name fields will appear one-after-the-other in particular memory locations, which will be named LNAME, FNAME and MI.

The goal then is to format and print the names, probably along with other data. For now, however, look only at the names. The most straightforward way to do this is to treat each field as containing a name using the whole field length. This approach produces the list shown in Figure 1. It's certainly functional, but it's not very elegant.

```
ADAMS           , DORIS      W
BRUBAKER        , HENRY      A
O CONNOR        , WILLIAM    M
DAY             , ED
MICHAELS        , ALICE      T
SMITH           , BONNIE     K
WILLIAMS JR     , WILL       V
```

Figure 1.

A better solution is the list in Figure 2, and doing it this way is what this article is about. First, look at what must be done and how to tackle the problem. Then a program can be written to do the job. Finally, a discussion of reasons for writing this kind of program will be given.

```
ADAMS, DORIS W
BRUBAKER, HENRY A
O CONNOR, WILLIAM M
DAY, ED
MICHAELS, ALICE T
SMITH, BONNIE K
WILLIAMS JR, WILL V
```

Figure 2.

A list is formatted one at a time in a memory area named LINE. LINE begins at the address ALINE. Begin by clearing LINE to blanks; then move the whole 15-character last name field to some beginning location, say ALINE+5. Now move to one position past the last name field, in this case ALINE+21, and start looking for non-blanks as the field is scanned backwards towards the left. When a non-blank is found, increment the address by one to point to the blank right after the name, and put a comma there. Again increment the pointer by one to leave a blank after the comma. The above procedure is repeated to move the first name field into LINE and find its "right-hand" end by scanning back for non-blanks. This time, just increment the address pointer by two to leave a blank after the first name, and move the middle initial to the LINE position pointed to. This completes moving the name fields so the routine should return to the calling program.

The program NLIST, written in 8080 assembly language and presented in Program 1, does the steps just outlined. LOPB fills the line with blanks, LOOP1 moves the last name and LOOP2 finds the actual end of the name field. LOOP3 and LOOP4 move and find the end of the first name field. The routine is easily modified to handle name fields of different lengths, a different starting point in LINE or a different LINE length. To change the last name length, change the constants in program lines 8 and 21; change the constants in lines 34 and 45 for a different length first name. The starting point in LINE is altered by changing the constant in line 12. The print line length is set by the LINE "DS" statement and appears as a constant in program line 1.

Now consider a few points on why the routine was written this way. First, why assembly language? There are two reasons worth considering for a business application. The code uses a minimum of memory and it runs fast. Moreover, even if the main-line program is in BASIC or another higher level language, many microprocessor BASICs can now call assembly subroutines.

Why begin by filling LINE with blanks? To insure that a blank is found when the scan for non-blanks begins. After all, the name in the field the last time through was probably not the same length as it is this time.

Why set up the counter in register B before starting the non-blank scan? If this seems over cautious, think what would happen if the name field were all blank. The program would keep scanning for a non-blank until it found one. The printed output line would not be at all what is expected. Business application programming must be very defensive; everything that can possibly go wrong will go wrong, so programs should be insured against loss when faced with unexpected input data. If the name fields are all blank, the printed line should be just a comma in position ALINE+5.

It's also possible to find the actual name field ends by scanning from the left and and looking for a blank. This works well most of the time but does not properly handle last names such as MC GEE, ST JOHN or DE WALD, when the names are entered with blanks as shown. It's safer to use the original method as this lets the businessman enter names in whichever form he wants.

In conclusion, it's well to again mention computing speed. In fact, speed is the main different these days between microcomputers and minicomputers. The minis are mostly designed with standard or Schottky TTL logic which is almost always faster than any of the microprocessor chips. To be competitive in database applications, as much speed as possible is needed.☐

ABOUT THE AUTHOR

Ron Tipton has a masters degree in electrical engineering and has been working with digital computers since the IBM 610 was the latest thing in computing hardware - about 20 years. He is presently a full-time consultant, mostly in the business application area. He is working with several makes of both micro and minicomputers.

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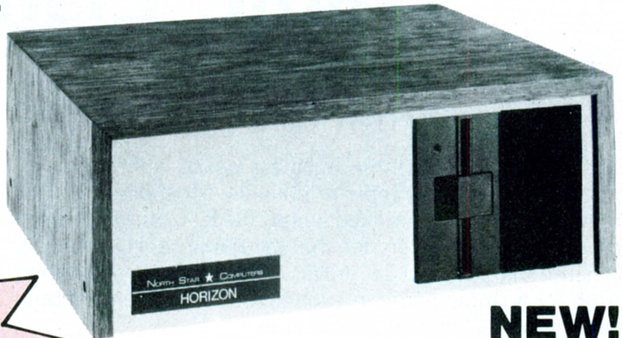

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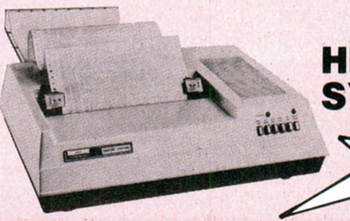

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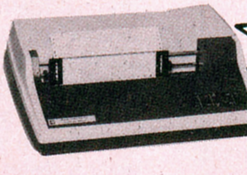

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PROGRAM LISTING

```
                               ;NAMELIST
                               ;
BLANK:   DB     20H            ;ASCII blank
COMMA:   DB     ','
LINE:    DS     132
ALINE:   DW     LINE           ;start address of LINE
                               ;
NLIST:   MVI    B,132          ;length of LINE
         LHLD   ALINE          ;point to start of LINE
         MVI    A,BLANK        ;load value of blank in accum
LOOPB:   MOV    M,A            ;move blank to LINE
         INX    H              ;increment LINE pointer
         DCR    B              ;decrement count
         JNZ    LOOPB          ;fill LINE with blanks
                               ;
         MVI    B,15           ;length of last name
         LHLD   LNAME          ;start address of last name
         XCHG
         LHLD   ALINE+5        ;point to last name start in LINE
         XCHG
LOOP1:   MOV    A,M            ;move character to accum
         XCHG
         MOV    M,A            ;move character to LINE
         INX    H
         XCHG
         INX    H
         DCR    B
         JNZ    LOOP1          ;continue until last name is moved
                               ;
         MVI    B,16           ;length of name + 1
         XCHG                  ;point to end of name + 1 in LINE
         MVI    A,BLANK        ;load value of blank in accum
LOOP2:   CMP    M              ;compare LINE character with blank
         JNZ    PUNCT          ;jump if character is a non-blank
         DCX    H              ;decrement LINE pointer
         DCR    B              ;decrement count
         JNZ    LOOP2
PUNCT:   INX    H              ;point to first blank after last name
         MVI    A,COMMA        ;load value of comma in accum
         MOV    M,A            ;put comma in LINE after last name
         INX    H              ;point to blank between names
         INX    H              ;point to first name start in LINE
                               ;
         MVI    B,10           ;length of first name
         XCHG
         LHLD   FNAME          ;start address of first name
LOOP3:   MOV    A,M            ;move character to accum
         XCHG
         MOV    M,A            ;move character to LINE
         INX    H
         XCHG
         INX    H
         DCR    B
         JNZ    LOOP3          ;continue until first name is moved
                               ;
         MVI    B,11           ;length of first name + 1
         XCHG                  ;point to end of name + 1 in LINE
         MVI    A,BLANK
LOOP4:   CMP    M              ;compare LINE character with blank
         JNZ    MI             ;jump if character is a non-blank
         DCX    H              ;decrement LINE pointer
         DCR    B              ;decrement count
         JNZ    LOOP4
MI:      INX    H              ;point to blank after first name
         INX    H              ;point to middle initial position in LINE
         XCHG
         LHLD   MI             ;address of middle initial
         MOV    A,M            ;move initial to accum
         XCHG
         MOV    M,A            ;move initial to LINE
         RET                   ;return
```

PAYDAY Program Listings Vectored from Page 69

```
0188 IF MID$(B$,14,1)="T" THFN 370
0190  G$=MID$(D$,X1*6+36,6):FOR Y=6 TO 1 STEP-1
0191 IF X1<>0 IF VAL("O"+MID$(B$,X1*7+40,7))=0 THEN 370
0192 IF MID$(G$,Y,1)=" "NEXT Y
0193  G$=LEFT$(G$,Y)
0194 IF X1<>0 IF VAL("O"+MID$(B$,X1*7+40,7))=0 THEN 370
0195 ? #Z,RIGHT$(O$+G$,12);
0200 FOR Y=5 TO 1STEP-1:IF MID$(A$,Y,1)=" " NEXT Y
0205 ? #Z;RIGHT$(O$+LEFT$(A$,Y),15);"   ";
0210 ? #Z,MID$(A$,6,32);TAB(68);:IF X1<>0 THEN 275
0220  A=VAL("O"+MID$(C$,8,7))+VAL("O"+MID$(C$,15,7))
0230  A=A+VAL("O"+LEFT$(D$,7))+VAL("O"+MID$(D$,8,7))
0240  A=A-(VAL("O"+MID$(D$,15,7))+VAL("O"+MID$(D$,22,7)))
0250  A=A-(VAL("O"+MID$(D$,29,7))+VAL("O"+MID$(C$,32,7)))
0260  A=A-(VAL("O"+MID$(B$,47,7))+VAL("O"+MID$(B$,54,7)))
0270  A=A-(VAL("O"+MID$(B$,61,7))+VAL("O"+MID$(B$,68,7)))
0273 GOTO 280
0275  A=VAL("O"+MID$(B$,X1*7+40,7))
0280 IF A=0 THEN 370
0283 DIGITS= 2:?#Z,RIGHT$(O$+STR$(A),15):L=L+1:C=C+1:T1=T1+A
0290 IF L>58 DIGITS=0:GOSUB 9000
0370 NEXT X
0380 FOR X=L TO 59:?#Z:NEXT X
0385 ? #Z,TAB(15),"TOTAL";
0390 ? #Z,TAB(68);RIGHT$(O$+STR$(T1),15)
0400  C=0:DIGITS=0:CLOSE#12:CHAIN MAIN
9000 ? #Z,CHR$(12):P=P+1:?#Z,TAB(11);"PAGE ";P
9010 ? #Z,TAB(L1-LEN(H$(0))/2);H$(0)
9020 ? #Z,"FEDERAL EMPLOYER # :   ";H$(3);TAB(L1-LEN(H$(1))/2);H$(1);
9030 ? #Z,TAB(87);"CHECKS ARE DATED ";H$(5)
9040 ? #Z,"  STATE EMPLOYER # :   ";H$(4);TAB(L1-LEN(H$(2))/2);H$(2)
9050  M$="REPORT OF ALL "+D$(X1)+"CHECKS PRINTED"
9051 ? #Z,TAB(L1-LFN(M$)/2);M$;TAB(87);
9055 ? #Z,"YTD PAYROLL # : ";
9060 ? #Z,Y1:?#Z,TAB(53);"FOR PERIOD ENDED ";H$(6):?#Z
9070 ? #Z,TAB(6);"CHECK #";TAB(24);"EMPLOYEE"
9080 ? #Z,TAB(26);"#    NAME";TAB(77);"AMOUNT":?#Z
9100  L=11:RETURN
```

PROGRAM 18

```
0010 REM STRT BAS WRITTEN 3/23/78 BY DAVE GARDNER
0020 STRING= 128:LINE=80:? CHR$(26)
0025  O$="          "
0030 ? "PLEASE INSERT THE CHECKS INTO THE PRINTER "
0040 ? "DO NOT ATTEMPT TO PRINT ON THE FIRST CHECK"
0050 ? "IN LINE.  WHEN THIS HAS BEEN COMPLETED ENTER"
0060 ? "THE CHECK NUMBER OF THE WASTED CHECK ";
0070 OPEN #10, MASTER FOR UPDATE
0080 FIELD #10, A$=92,B$=104,C$=59
0100 INPUT A:GET #10:D$=MID$(C$,52):C$=LEFT$(C$,42)
0105  X$=RIGHT$(C$,8)
0110  C$=C$+LEFT$(STR$(A+1)+O$,9)+D$
0115 REWRITE #10:CLOSE #10
0120 OPEN #11, MASTE1 FOR UPDATE
0130 FIELD #11, A$=87,B$=96,C$=72
0140 GET #11:D$=MID$(A$,51)
0150  A=VAL("O"+MID$(A$,45,6)):A$=LEFT$(A$,44)+LEFT$(STR$(A+1)+O$,6)+D$
0160  D$=MID$(C$,26):C$="O"
0170 INPUT "CURRENT PERIOD ENDING DATE ",E$
0180  C$=C$+LEFT$(E$+O$,9):E$=X$:C$=C$+E$+" "
0190 FOR X=0 TO 2
0200 ? "SHOULD I PAY ";MID$(D$,X*13+8,13);" EMPLOYEES ";
0210 INPUT E$:IF ASC(E$)=89 C$=C$+"1":GOTO 230
0220  C$=C$+"O"
0230 NEXT X
```

PROGRAM 19B

```
0395  A$=A$+LEFT$(STR$(C)+O$,7)+D$:REWRITE #11
0400 CLOSE #11,#12,#13:CHAIN PWR1
6000  W1=ABS(W)-INT(ABS(W)):Z$(4)="0000000000"+STR$(INT(ABS(W)))
6010  Z$(4)=RIGHT$(Z$(4),9):Z$=""
6020 FOR W2=2 TO 0 STEP -1
6030  Z$(5)=MID$(Z$(4),W2*3+1,3):IF VAL(Z$(5))=0 THEN 6140
6035 IF W2=1 Z$=" THOUSAND"+Z$
6037 IF W2=0 Z$=" MILLION"+Z$
6040  W3=VAL(MID$(Z$(5),2)):IF W3>19 THEN 6080
6050 IF W3=0 THEN 6120
6060 IF W3<11 THEN 6090
6070  K8=VAL(MID$(Z$(2),(W3-11)*10+1,1))
6071  Z$=" "+MID$(Z$(2),(W3-11)*10+2,K8)+Z$
6075 GOTO 6120
6080  W3=VAL(MID$(Z$(5),3,1)):IF W3=0 THEN 6100
6090  K8=VAL("O"+MID$(Z$(1),W3*10-9,1))
6091  Z$=" "+MID$(Z$(1),(W3-1)*10+2,K8)+Z$
6095 IF VAL(MID$(Z$(5),2))<20 THEN 6120
6100  W3=VAL(MID$(Z$(5),2,1)):IF W3<2 THEN 6120
6110  K8=VAL(MID$(Z$(3),(W3-1)*10+1,1))
6111  Z$=" "+MID$(Z$(3),(W3-1)*10+2,K8)+Z$
6120  W3=VAL(LEFT$(Z$(5),1)):IF W3=0 THEN 6140
6130  K8=VAL(MID$(Z$(1),W3*10-9,1))
6135  Z$=" "+MID$(Z$(1),W3*10-8,K8)+" HUNDRED"+Z$
6140 NEXT W2
6145  K8=INT(W1*100):Z$=Z$+" AND "
6147 IF K8<10 THEN Z$=Z$+"0"
6150  Z$=Z$+STR$(K8)+"/100 DOLLARS"
6153 IF INT(ABS(W))=0 Z$=" ZERO"+Z$
6155 IF W<0 Z$=" NFGATIVE"+Z$
6157  Z$=MID$(Z$,2):RETURN
6160 DIM Z$(5)
6170  Z$(1)="3ONE      3TWO      5THREE    4FOUR     4FIVE     3SIX
6180  Z$(1)=Z$(1)+"5SEVEN    5EIGHT    4NINE     3TEN      "
6190  Z$(2)="6ELEVEN   6TWELVE   8THIRTEEN 8FOURTEEN 7FIFTEEN  7SIXTEEN
6200  Z$(2)=Z$(2)+"9SEVENTEEN8EIGHTEEN 8NINETEEN            "
6210  Z$(3)="          6TWENTY   6THIRTY   5FORTY    5FIFTY    5SIXTY
6220  Z$(3)=Z$(3)+"7SEVENTY  6EIGHTY   6NINETY             "
6230 RETURN
9000 REM
9001 IF A<=0 M$=M$+"999999":RETURN
9005 IF D(A2)=1 M$=M$+"999999":RETURN
9010  M$=M$+LEFT$(STR$(C1)+"      ",6):C1=C1+1:C=C+1
9030  W=A:GOSUB 6000
9040 FOR X5=0 TO 5:?#Z:NEXT X5
9050 ? #Z,TAB(65);Q$:?#Z:?#Z
9060 DIGITS= 2:?#Z,TAB(9);Z$;TAB(71);:Z$=RIGHT$(O$+STR$(A),15):DIG
9070 FOR X5=1 TO 15:IF MID$(Z$,X5,1)=" " NEXT X5
9080 ? #Z,MID$(Z$,X5-1):?#Z:?#Z:?#Z
9090 IF A2<>0 ?#Z:?#Z:?#Z:GOTO 9130
9100 FOR X5=0 TO 2
9110 ? #Z,TAB(13);MID$(A$,X5*30+INT(X5/2+.5)*2+6,30+(2-IN
9120 NFXT X5
9130 ? #Z,TAB(13);D$(A2)
9140 FOR X5=1 TO 10:?#Z:NEXT X5:IF A2<>0 THEN 9300
9300 RETURN
```

PROGRAM 20

```
0010 REM HSTY.BAS WRITTEN 3/25/78 BY DAVE GARDNER
0020 STRING= 128:LINF=0:?CHR$(26):DIMH$(4),T$(2),E$(2),T(6)
0025  Z=4
```

```
0240  C$=C$+"000"+D$:REWRITE #11:CLOSE #11
0250 CHAIN PINP
```

PROGRAM 19A

```
0010 REM PCHK BAS WRITTEN 3/23/78 BY DAVE GARDNER
0015 REM ADAPTED BY RANDY JACKSON--PERSONAL COMPUTER PLACE
0020 STRING= 128:LINE=0:? CHR$(26)
0022  O$="                    "
0025  Q$="JANUARY  FEBRUARY MARCH    APRIL    MAY       JUNE     "
0027  Q$=Q$+"JULY     AUGUST   SEPTEMBEROCTOBER  NOVEMBER DECEMBER "
0028 ? TAB(10),"PAYCHECK PRINTING PROGRAM":?:?:?:?:?:?
0030 OPEN #10, MASTER FOR INPUT
0040 FIELD #10, A$=92, B$=104, C$=59
0050 GET #10:CLOSE #10:DIM H$(6),D$(4),D(4),B(7)
0052 ? "W O R K I N G ! !":?:?
0055  H$(0)=MID$(A$,7,46):H$(1)=MID$(A$,53,40):H$(2)=LEFT$(B$,40)
0060  H$(3)=MID$(A$,41,32):H$(4)=MID$(B$,73)
0065  C1=VAL("0"+MID$(C$,43,9)):X$=RIGHT$(C$,8)
0070 FOR X=0TO4:FORY=LEN(H$(X))TO1STEP-1
0075 IF MID$(H$(X),Y,1)=" " NEXT Y
0080  H$(X)=LEFT$(H$(X),Y):NEXT X
0085  Q$=MID$(Q$,9*VAL(X$)-8,9)
0086 FOR Y=9 TO 3:IF MID$(Q$,Y,1)=" " NEXT Y
0087  Q$=LEFT$(Q$,Y)+" "+STR$(VAL(MID$(X$,4,2)))+", 19"+MID$(X$,7)
0090 OPEN #11, MASTE1 FOR INPUT
0100 FIELD #11, A$=119, B$=96, C$=40
0110 GET #11:CLOSE#11:H$(5)=MID$(B$,75,8):H$(6)=MID$(B$,66,8)
0111 ? CHR$(26):? "STILL W O R K I N G ! !":?:?:?:?
0112  D$(1)=MID$(A$,88):D$(2)=LEFT$(B$,32):D$(3)=MID$(B$,33,32)
0113  C=VAL("0"+MID$(A$,81,7)):FOR X=0TO3:FOR Y=LEN(D$(X))TO1STEP-1
0114 IF MID$(D$(X),Y,1)=" " NEXT Y
0115  D$(X)=LEFT$(D$(X),Y):NEXT X
0120  N1=VAL("0"+MID$(A$,51,3)):Y1=VAL("0"+MID$(A$,45,6))
0123  D$(0)="":D$(4)="SPECIAL DEDUCTION"
0125 LET D(0)=0:FORX=1TO4:D(X)=1:NEXT X
0130 OPEN #12, PERFIL FOR INPUT
0140 FIELD #12, A$=103, B$=103, C$=49
0150 OPEN #13, EMPHST FOR UPDATE
0160 FIELD #13, D$=100, E$=104, F$=51
0170 GOSUB 6160
0175  Z=4
0180 FOR X=1 TO N1:GET#12:IF MID$(B$,23,8)<>X$THEN 370
0185  M$=""
0190 GET #13:A2=0
0220  A=VAL("0"+MID$(C$,8,7))+VAL("0"+MID$(C$,15,7))
0230  A=A+VAL("0"+LEFT$(D$,7))+VAL("0"+MID$(D$,8,7))
0240  B(0)=A:B(2)=VAL("0"+MID$(D$,15,7)):B(3)=VAL("0"+MID$(D$,22,7))
0250  B(1)=VAL("0"+MID$(D$,29,7)):B(0)=B(0)-VAL("0"+MID$(C$,32,7))
0260  B(4)=VAL("0"+MID$(B$,47,7)):B(5)=VAL("0"+MID$(B$,54,7))
0270  B(6)=VAL("0"+MID$(B$,61,7)):B(7)=VAL("0"+MID$(B$,68,7))
0275  A=B(0):FORW1=1TO7:A=A-B(W1):NEXTW1
0280 GOSUB 9000
0285  A2=0
0290  A2=A2+1
0295 IF VAL("0"+MID$(B$,A2*7+40,7))=0 THEN 360
0300  A=VAL("0"+MID$(B$,A2*7+40,7))
0350 GOSUB 9000
0355 GOTO 365
0360  M$=M$+"0      "
0365 IF A2<>4 THEN 290
0366  G$=MID$(D$,66):D$=LEFT$(D$,35)+M$+G$
0367 REWRITE #13
0370 NEXT X
0380 OPEN #11, MASTE1 FOR UPDATE
0385 FIELD #11, A$=100,B$=100,C$=55
0390 GET #11:D$=MID$(A$,88):A$=LEFT$(A$,80)
```

```
0030  T$(0)="MTD006607200730790080086008709300941001001007100801 4"
0040  T$(1)="QTD102903610370441045051105205810590651066073107408 1"
0050  T$(2)="YTD109610420010092010016201702320240302031037203804 4"
0060  O$="                                                              "
0070 ? "DO YOU WISH TO DISPLAY:":?:?
0080 FOR X=0TO2:?X+1;TAB(5);"REPORT OF ALL ";LEFT$(T$(X),3);" FIGURES":?
0085 NEXT X
0090 ? :INPUT"SELECTION (0 TO EXIT) ",A
0100 IF A=0 THEN
0110 IF A>0 IF A<4 IF A=INT(A) THEN 130
0120 ? CHR$(7);"ILLEGAL SELECTION!!!":GOTO 70
0130  A=A-1:OPEN #10, MASTER FOR INPUT
0140 FIELD #10, A$=92,B$=104,C$=59
0150 GET #10:CLOSE #10:L1=66
0155  X$=RIGHT$(C$,8)
0160  H$(0)=MID$(A$,7,46):H$(1)=MID$(A$,53)
0165  H$(2)=LEFT$(B$,40)
0170 FOR X=0 TO 2:FOR Y=LEN(H$(X)) TO 1 STEP-1
0175 IF MID$(H$(X),Y,1)=" " NEXT Y
0180  H$(X)=LEFT$(H$,Y):NEXT X
0185  H$(0)=RIGHT$(O$+H$(0),L1-LEN(H$(0))/2):D$=H$(1)
0190  H$(1)="  FED  EMP.  # :"+MID$(B$,41,32)
0195  H$(1)=LEFT$(H$(1)+O$,L1-LEN(D$)/2)+D$:D$=H$(2)
0200  H$(2)="  STATE EMP.  #:"+MID$(B$,73)
0205  H$(2)=LEFT$(H$(2)+O$,L1-LEN(D$)/2)+D$
0210  H$(3)="REPORT OF ALL "+LEFT$(T$(A),3)+" FIGURES"
0220  H$(3)=RIGHT$(O$+H$(3),L1-LEN(H$(3))/2)
0225  H$(4)=" AS OF "+X$
0230 OPEN #11, MASTE1 FOR INPUT
0240 FIELD #11, A$=87,B$=96,C$=72
0250 GET #11:CLOSE #11:N1=VAL("0"+MID$(A$,51,3))
0260 OPEN #12, PERFIL FOR INPUT
0270 FIELD #12, A$=103,B$=103,C$=49
0280 OPEN #13, EMPHST FOR INPUT
0290 FIELD #13, D$=100,E$=104,F$=51
0295 INPUT "WHEN THE PRINTER IS READY PRESS 'RETURN'",A$
0300 GOSUB 9000
0310 FOR X=1 TO N1
0320 GET #12:GET #13:E$(0)=D$:E$(1)=E$:E$(2)=F$
0330 FOR Y=5 TO 1 STEP-1:IF MID$(A$,Y,1)=" " NEXT Y
0335  B$=LEFT$(A$,Y):?#Z,TAB(7-LEN(B$));B$;TAB(11);MID$(A$,6,32);
0340 ? #Z,TAB(46);
0350 FOR X1=0 TO 6
0360  X2=VAL(MID$(T$(A),X1*7+4,1)):X3=VAL(MID$(T$(A),X1*7+5,3))
0370  X4=VAL(MID$(T$(A),X1*7+8,3))
0380  A1=VAL("0"+MID$(E$(X2),X3,X4-X3+1)):GOSUB 8000
0385  T(X1)=T(X1)+A1
0390 NEXT X1
0400 ? #Z:L=L+1:IF L>58 GOSUB 9000
0410 NEXT X
0420 FOR X=L TO 59:?#Z:NEXT X
0430 ? #Z,"  TOTALS   ";
0440 DIGITS= 2:FOR X=0TO6:?#Z,RIGHT$(O$+STR$(T(X)),15)+"";" ";:NEXT X
0445 DIGITS= 0:?#Z
0450 CLOSE #12,#13:CHAIN MAIN
8000 DIGITS= 2
8010 ? #Z,RIGHT$(O$+STR$(A1),10);"  ";:DIGITS=0
8015 DIGITS= 0
8020 RETURN
9000  P=P+1:?#Z,CHR$(12):?#Z,"  PAGE ";P
9010 FOR R1=0 TO 2:?#Z,H$(R1):NEXT R1
9012 FOR R1=3 TO 4:?#Z,H$(R1);:NEXT R1
9015 ? #Z
9020 ? #Z,"       EMPLOYEE";TAB(47);"REGULAR     OVERTIME       FIT";
9030 ? #Z,"          SIT           FICA         BONUS        EXPENSE"
9040 ? #Z,"       #   NAME";TAB(50);"PAY             PAY";TAB(121);"REIMB "
9050 ? #Z:L=12:RETURN
```

National Technical Schools Mini-Series of Basic Electronics Unit 3 Continued

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TABLE OF CONTENTS

Electronic System 108
OR Gate 108
NOT Concept 109
Combination of OR, AND, NOT Circuits 109
Simplified Circuit 109
Electronic System 109
Exclusive OR Circuit 110
Analysis of Reasoning 110
Alternate Circuit 110
Boolean Algebra 111
Propositional Logic 111
Analogy Between Complex Propositions and Switching Circuits 111
Operational Rules 111
Basic Rules 111
AND Relation 111
OR Relation 112
Operation with Variables 112
Basic Theorems 112
Adding Variables 114
Complement Rules 114
Logic Approach 115
Distributive Law 115
Transformation and Minimizing of Circuits 116
Minimizing Complex Expressions 116
Demorgan's Theorems 116
Operational Rules 118
Boolean Theorems 119

Last month, number systems prevalent in digital computer operations were discussed, and logic elements introduced. This month we will conclude Unit Three with the continuation of logic elements and the basics of Boolean Algebra.

ELECTRONIC SYSTEM

In electronic digital systems an AND gate behaves in a manner similar to the AND relay circuit, although it is not identical in configuration. That is, the AND gate has two or more input terminals but produces an output only when an input is present at all of its input terminals. For this reason, the AND circuit is sometimes referred to as a "coincidence" circuit. In other words, input signals must be present at all input terminals at the same time.

Two other names for the AND gate are AND circuit and logic AND circuit. In Figure 48 we show the symbols commonly employed to identify the AND circuit. (Some manufacturers use their own symbols to identify the logic circuits in their equipment.)

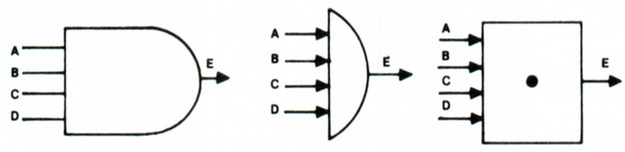


Figure 48. Symbols representing "AND" gate.

As can be seen in Figure 49, an output can be obtained from this circuit only during the instant when all inputs are active. AND circuits can be designed to respond to d-c inputs or to pulse inputs, as shown in Figure 49. Furthermore, the circuit can be designed to respond to negative input pulses rather than the positive ones shown in Figure 49.

In the symbols presented in Figure 48, no return circuit is shown since it is accepted that both input and output circuits use ground as the common return paths.

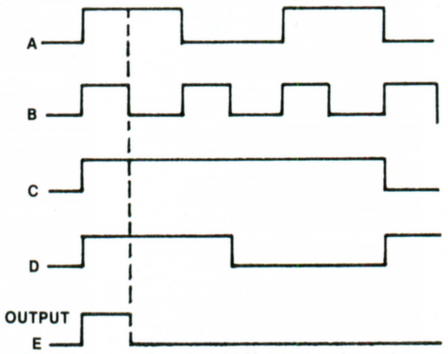


Figure 49. "AND" gate signals.

OR GATE

Relay System

Returning to the example of an elevator, let us forget that there is a safety button at the door and assume that there are two call buttons, A and C. The elevator must operate whenever one of these two buttons is depressed.

To obtain this action, we connect the contacts of the corresponding relays in parallel as shown in Figure 50. So the motor of the elevator is energized when button A or button C is depressed, *or* when both buttons are depressed simultaneously. This coincides with the definition of A + C. So the condition OR is equivalent to placing the contacts, or the variables, in parallel.

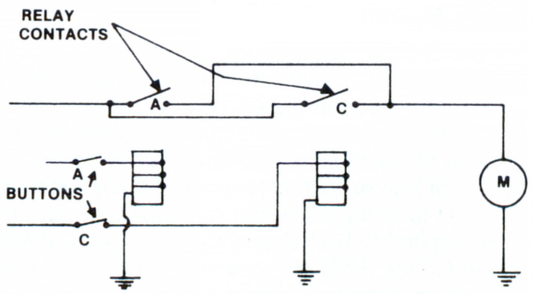


Figure 50. "OR" gate, using relays.

Electronic System

In electronic digital systems an OR gate, although not identical in configuration, behaves in a similar manner to the relay circuit just explained. That is, the OR gate has two or more input terminals and produces an output when input is applied to at least one of the input terminals, as shown in Figure 52.

In Figure 51 we present the symbols commonly employed to identify the OR gate.

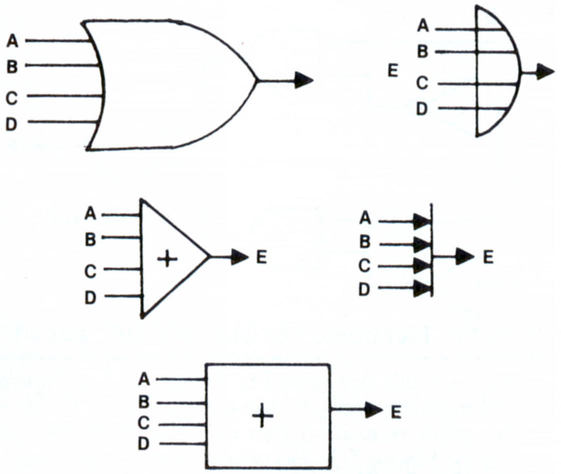


Figure 51. Symbols representing "OR" gate.

As with the AND gate, the OR gate can be designed to respond to either d-c or pulse type inputs, and can be designed to respond to negative rather than the positive inputs shown in Figure 52. Other names given to the OR gate are OR circuit and diffused mixer.

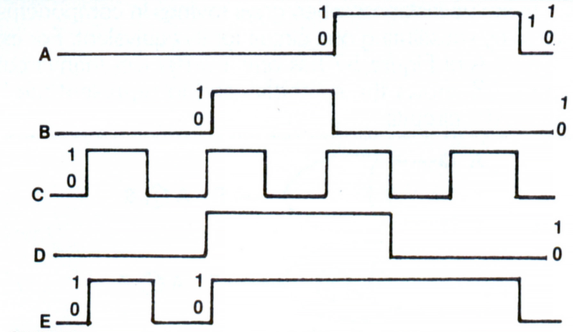


Figure 52. "OR" gate signals.

"NOT" CONCEPT (INVERTER)

Relay System

Continuing with the example of the elevator, suppose that we want to provide the system with an emergency button D, which can stop the elevator at will.

For this type of operation, we must provide the circuit with a relay contact that operates in an inverse manner to the contacts of the call and safety relays. That is, the contact must be normally closed (on) when the coil of the relay is not energized and must open the circuit when button D is depressed, as shown in Figure 53.

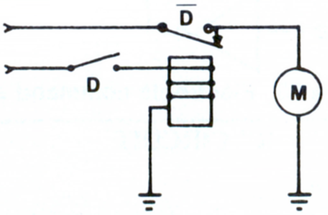


Figure 53. "NOT" circuit, using relay.

COMBINATION OF OR, AND, AND NOT CIRCUITS

Relay System

We are now ready to make a complete command system. That is, we want an elevator (E) that can be started with either of two buttons, A or C, but only if the door safety button (B) is closed (on) and the emergency button (D) is off. Analyzing the requirements, we find that the contacts actuated by the relays of buttons A and C must be connected in parallel. We also have an AND relation between the contacts of relays B and D and the parallel (A+C) relation. The requirements of the circuit will be accomplished by connecting in series contacts B, D and the parallel (A+C), as shown in Figure 54.

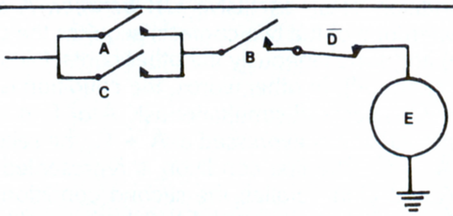


Figure 54. Elevator Command System.

Simplified Circuit

In Figure 54 we show only the contacts and not the relays, since the contacts are actuated when the relays are excited and return to their normal position when the relay is not excited. Due to this direct relation between a relay and the contact (or contacts) that it controls, the contact (or contacts) of this relay can be identified by the same letter used to designate the function of the relay.

For example, the three contacts of a relay employed to start a three-phase motor close when the relay is energized by depressing the "Start" button. Therefore, if the starting relay is identified by the letter "S", then all the contacts actuated by this relay can be identified by the letter "S". When relay S closes, all the S contacts close. The relay symbol can therefore be removed from the schematic, but then it must be understood that the letters assigned to the contacts represent the signal applied to the relay.

Electronic System

Figure 55 shows the equivalent computer logic circuit of Figure 54. Note in Figure 55 that in order to obtain an output E of this logic circuit the AND gate must receive a signal from the OR gate (signals applied either to A or C) and from branch B and from branch D; but in order to receive a signal from branch D, no signal must be present at the input of the inverter circuit.

If the circuit is operating and a signal is applied to the input of the inverter, no signal will be obtained from its output and the AND circuit will not have an output signal.

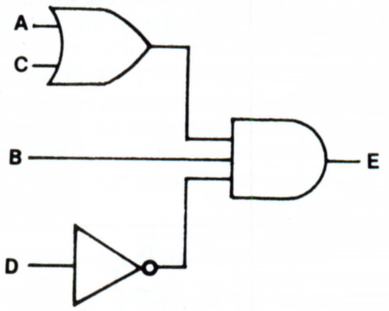


Figure 55. Electronic command system.

EXCLUSIVE "OR" CIRCUIT

Relay System

Continuing with our example of the elevator, suppose that we want to complicate its control circuit further by including an exclusive OR circuit, instead of the inclusive OR circuit which was provided previously. That is, we want the elevator to operate when only one of the call buttons A or C is depressed.

The parallel circuit of Figure 50 permits the elevator to operate when any of these buttons is depressed, but also when both buttons are depressed at the same time. That is what we want to avoid.

What we need then is a circuit that, without altering the operation of the parallel buttons A and C, stops the current flow to the motor when both buttons are depressed simultaneously.

Analysis of Reasoning

We can follow this reasoning:

The condition of an exclusive OR between A and C is satisfied when one of the two contacts acquires the condition of yes (on) and simultaneously the other contact acquires the condition of no (off). In other words, the condition is satisfied when A or C is yes and simultaneously A or C is no.

The first condition is expressed at A + C; the second condition as $\overline{A} + \overline{C}$. The first condition is represented by front contacts A and C in parallel; the second condition as back contacts $\overline{A}$ and $\overline{C}$ also in parallel. Since both conditions must be satisfied simultaneously (AND concept), both parallel circuits must be connected in series, as shown in A of Figure 56.

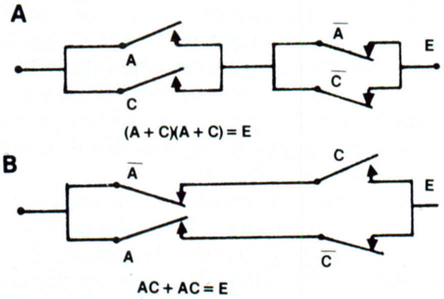


Figure 56. Exclusive "OR" relay circuit.

Expressing this circuit arrangement symbolically, $(A + C)(\overline{A} + \overline{C}) = E$. This combination of four contacts gives us an exclusive OR circuit between A and C. Even though four contacts are used, there are only two variables. We can therefore use two relays corresponding to the two variables; installing on each relay one front and one back contact that corresponds to the variable and its negation (complement).

Alternate Circuit

We could have followed this other reasoning: The exclusive OR is satisfied (elevator operates) when A is NOT and C is YES or when A is YES and C is NOT. Symbolically this would be expressed as $\overline{A}C + A\overline{C} = E$, and is read: If C but not A is on, OR is A but not C is on, then E (condition E) is obtained. (The = sign is read "then".)

To obtain this form of a circuit, we can connect a back contact $\overline{A}$ in series with the front contact C, and this circuit in parallel with a series circuit formed by a front contact A in series with a back contact $\overline{C}$, as shown in B of Figure 56.

This circuit so obtained is equivalent to that shown at A of Figure 56.

Electronic System

In Figure 57 we present the electronic logic diagram equivalent to the exclusive OR circuit of Figure 56. In this electronic Logic diagram the AND, OR, and inverter circuits are connected in various combinations in order to obtain the same results of the circuits illustrated in Figure 56.

Note at A of Figure 57 that is an input is applied to either A or C (but not to both) an output will appear at terminal E. If inputs are applied to both A and C, no output will appear at E, because (1) the AND circuit which feeds into the inverter will produce an output; (2) the inverter will produce no output because it receives an input; (3) since the inverter produces no output; the AND circuit that follows produces none.

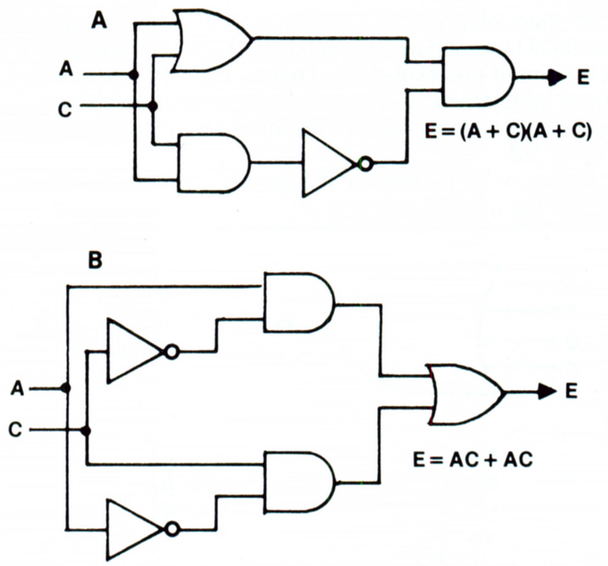


Figure 57. Electronic "EXCLUSIVE OR" circuit.

As with the circuits of Figure 56, the circuit A of Figure 57 is described mathematically by the equation $(A + C)(\overline{A} + \overline{C}) = E$. The same reasoning can be applied to the circuit shown at B of Figure 57. However, in this latter case, the equation is $(\overline{A}C + A\overline{C}) = E$.

Returning to Figure 56, if one of the two circuits were included in a sealed box, or black box, as it is usually called, we could not tell from the outside which of the two circuits is employed. Neither of these two circuits has any advantage over the other, since both require four contacts and two relays to accomplish their purpose.

But there are instances when great savings in components are achieved by substituting one circuit for its equivalent. For example, circuit A of Figure 57 has one inverter less than circuit B.

Figure 58 shows the symbols used to represent the "Exclusive OR" circuits.

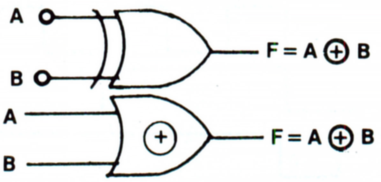


Figure 58. Symbols used to represent the EXCLUSIVE OR circuit.

If we call *yes* to the action of a normally open or "front contact" which when depressed permits a circuit to operate, then we have to call *not* or inverter to a normally closed or "back contact" which when energized opens the circuit. So the logic condition of operation of this switch is NOT D or $\overline{D}$ (the line on top of the letter means not).

Electronic System

In electronic digital systems a NOT circuit operates in a similar manner to that of the normally closed or back relay contact. That is, the NOT circuit, also called an inverter circuit, produces an output when an input is not applied.

If an input is applied, the circuit produces no output. The circuit therefore represents the function of negation or inversion.

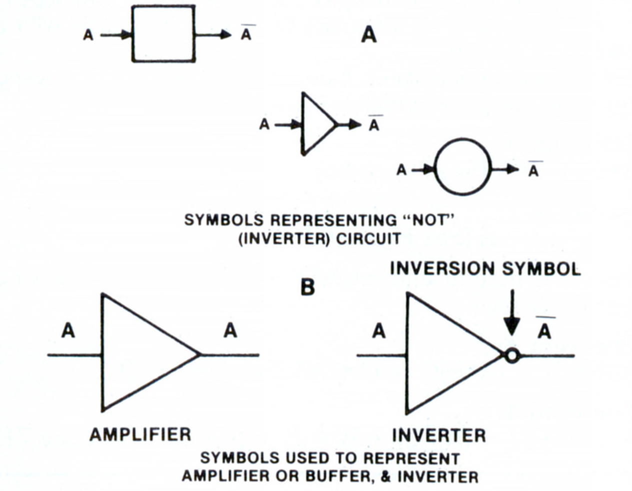

A
$\overline{A}$
A
A
$\overline{A}$
A
$\overline{A}$
SYMBOLS REPRESENTING "NOT" (INVERTER) CIRCUIT
INVERSION SYMBOL
B
A
A
A
$\overline{A}$
AMPLIFIER
INVERTER
SYMBOLS USED TO REPRESENT AMPLIFIER OR BUFFER, & INVERTER

Figure 59.

In Figure 59 we present the symbols usually employed to identify the noninverting amplifier or buffer and the NOT or INVERTER circuit. As with the AND and OR gate, the NOT circuit can be designed to respond to either d-c or pulse-type inputs, and can be designed to respond to negative rather than to the positive input shown in Figure 60.

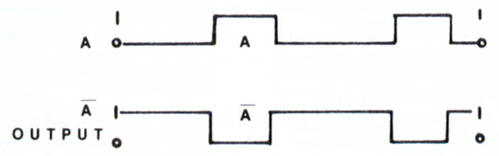


Figure 60. "NOT" circuit signals.

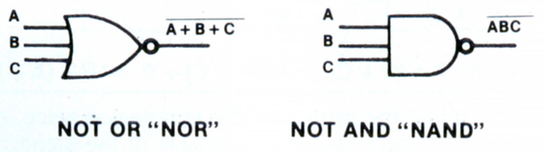


Figure 61.

Figure 61 shows the logic symbols used to denote "NOR" and "NAND" circuits. Also shown at the output of each is the Boolean expression for that output. We can readily see that the following outputs of single logic elements are easily identifiable, such as A+B, AB, $\overline{A}B+A\overline{B}$ which represent the the OR, AND and Exclusive OR logic functions, respectively. A tool that enables us to readily define multi element circuits is that of Boolean Algebra.

BOOLEAN ALGEBRA

When the first investigations on switching circuits were made, a tool was required that would give the same results in solving switching problems that regular algebra gives in solving other engineering problems.

This special "switching algebra" was developed rapidly for two reasons. The first reason was that the "tool" (Boolean algebra) had already been in existence for more than a century; the second reason was "technical ingenuity," or, in this case, learning how to apply old mathematical principles to a new field.

PROPOSITIONAL LOGIC

When we make a statement about something or somebody, we make this statement in the form of a proposition. What is important is if the proposition is true or false.

If the proposition is true, it is assigned a value of "one." If the proposition is false, it is assigned a value of "zero." Thus, all propositional calculations involve two values: 1 or 0, true or false, yes or no.

There are statements which are complex and to which it is more difficult to assign proper values.

ANALOGY BETWEEN COMPLEX PROPOSITIONS AND SWITCHING CIRCUITS

An American scientist, Claude Shannon, first noticed the analogy between complex propositions and the operation of switching circuits. So close is this analogy that the algebra created by George Boole (Boolean algebra) to solve these propositions can be applied to these circuits without modifications.

The relationship between the value of a complex proposition as a whole, and the value of its individual components, is identical to the relationship that exists between an electric circuit containing a great number of contacts, and the condition of the individual contacts. It is only necessary to change the notion of "true" for a proposition to a "closed circuit" and the notion of "false" to an "open circuit", and to use the "1" and "0" of Boolean algebra to represent a "closed" and an "open" circuit respectively.

The same thing happens with logic relations; the "br" which is expressed in Boolean algebra by the "+" sign represents a parallel connection, and the "and" which expresses multiplication in Boolean algebra represents a series connection.

OPERATIONAL RULES OF BOOLEAN ALGEBRA

The operational rules and basic theorems of Boolean algebra can be studied by following one of two methods. One of these would be the "logic method" followed by Boole. The other method, which we will use since it is easier to understand, is based on an electrical analogy.

However, an understanding of both methods, circuitral and logical, helps to develop the mental ability to visualize a switching problem from two points of view, as a logic structure and as a circuit. Once this ability has been developed, the solving of logic functions is easily achieved. For this reason, when possible, logic analogies of switching circuits will also be presented in our discussion.

BASIC RULES

As was previously mentioned, Boolean algebra makes use of only two numbers, one and zero; and two logic relations, "or" and "and." In order to understand the algebraic manipulation of these numbers and relations, we must study first their basic arithmetic operational rules.

"And" Relation

We will start with the relation "and" or a series connection.

Being two numbers (1 and 0), there are four possibilities in this logic multiplication. The first possibility is 0•0. (The dot between the two zeros denotes multiplication.) This operation is equivalent to connecting two open circuits in series. Therefore, there will be no continuity between the input and output terminals, and the result is an open circuit, so: 0•0=0 (See Figure 62).

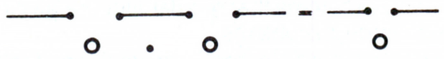


Figure 62. 0 • 0 = 0

The second and third possibilities are identical: 0•1 and 1•0. Both expressions correspond to a closed circuit connected in series with an open circuit. The result is an open circuit, so: 0•1 = 1•0 = 0 (See Figure 63).

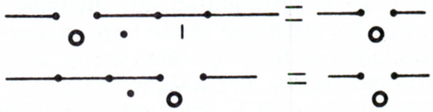


Figure 63. 0 • 1 = 0 AND 1 • 0 = 0

The last possibility is 1•1, which corresponds to two closed circuits connected in series. The result is a closed circuit between input and output. Therefore: 1•1 = 1 (See Figure 64).

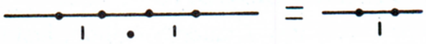


Figure 64. 1 • 1 = 1

"Or" Relation

Here we also have four possibilities. The first, 0+0, corresponds to two open circuits in parallel; the result is an open circuit between input and output; therefore: 0+0=0 (See Figure 65).

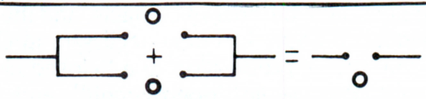


Figure 65. 0 + 0 = 0

The second and third possibilities, 0+1 and 1+0, can be represented by a closed circuit in parallel with an open circuit. Since the input and output terminals are connected to both the open and the closed branches, there will be continuity and the result is a closed circuit, so: 0+1=1+0=1 (See Figure 66).

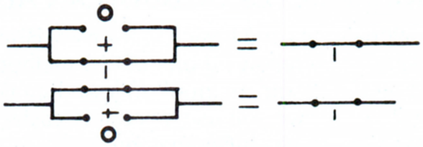


Figure 66. 0 + 1 = 1 AND 1 + 0 = 1

The arithmetical operations studied above are no different from those studied in elementary arithmetic. However, the difference is found when two closed circuits are connected in parallel, that is, in the fourth possibility, 1+1. Since a circuit can either be open or closed, but never more than closed, the result of this operation will also be "one', that is: 1+1=1 (See Figure 67).

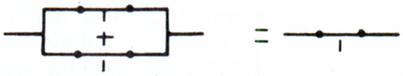


Figure 67. 1 + 1 = 1

This expression may seem strange, but we must remember that "+" does not mean addition in logic relations, but rather "or."

The basic Boolean arithmetic rules can be presented in the form of a table as follows:

Logic Addition	Logic Multiplication
0 + 0 = 0	0 • 0 = 0
0 + 1 = 1	0 • 1 = 0
1 + 0 = 1	1 • 0 = 0
1 + 1 = 1	1 • 1 = 1

Table 12.

OPERATION WITH VARIABLES

We have seen how arithmetical operations are performed by employing "1" and "0" to indicate the condition of fixed circuits, using "1" to represent a closed circuit and "0" to represent an open circuit. Now, let's see what happens if we substitute contacts for the fixed circuits. Contacts, as you know, can be actuated one by one, or in groups, by relays: they close (turn on) when the relay closes and open (turn off) when the relay opens, or vice versa.

Basic Theorems in Boolean Algebra

The fundamental relations in Boolean algebra as applied to switching circuits (variables), are: An expression of the type A•B corresponds to a contact of relay A connected in series with a contact of relay B. An expresssion of the type A + B corresponds to a contact of relay A in parallel with a contact of relay B.

It is easy to understand, then, the veracity of the following commutative (transformation) laws:

Theorem 1:
A•B = B•A (See Figure 68)

Theorem 2:
A+B = B+A (See Figure 69)

Also, it is easy to understand the veracity of the following associative laws.

Theorem 3:
A (B•C) = (A•B)C = (A•C)B (See Figure 70)

Theorem 4:
A + (B+C) = (A+C) + B = B + (A+C) (See Figure 71)

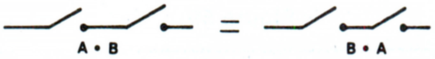


Figure 68. A•B = B•A

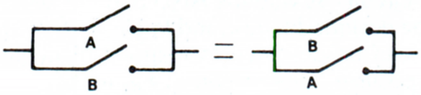


Figure 69. A + B = B + A

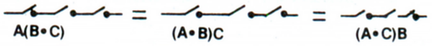


Figure 70. A(B•C) = (A•B)C = (A•C)B

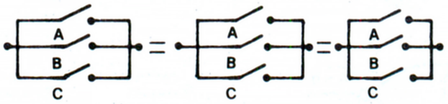


Figure 71. A + (B + C) = (A + – C) + B = B + (A + C)

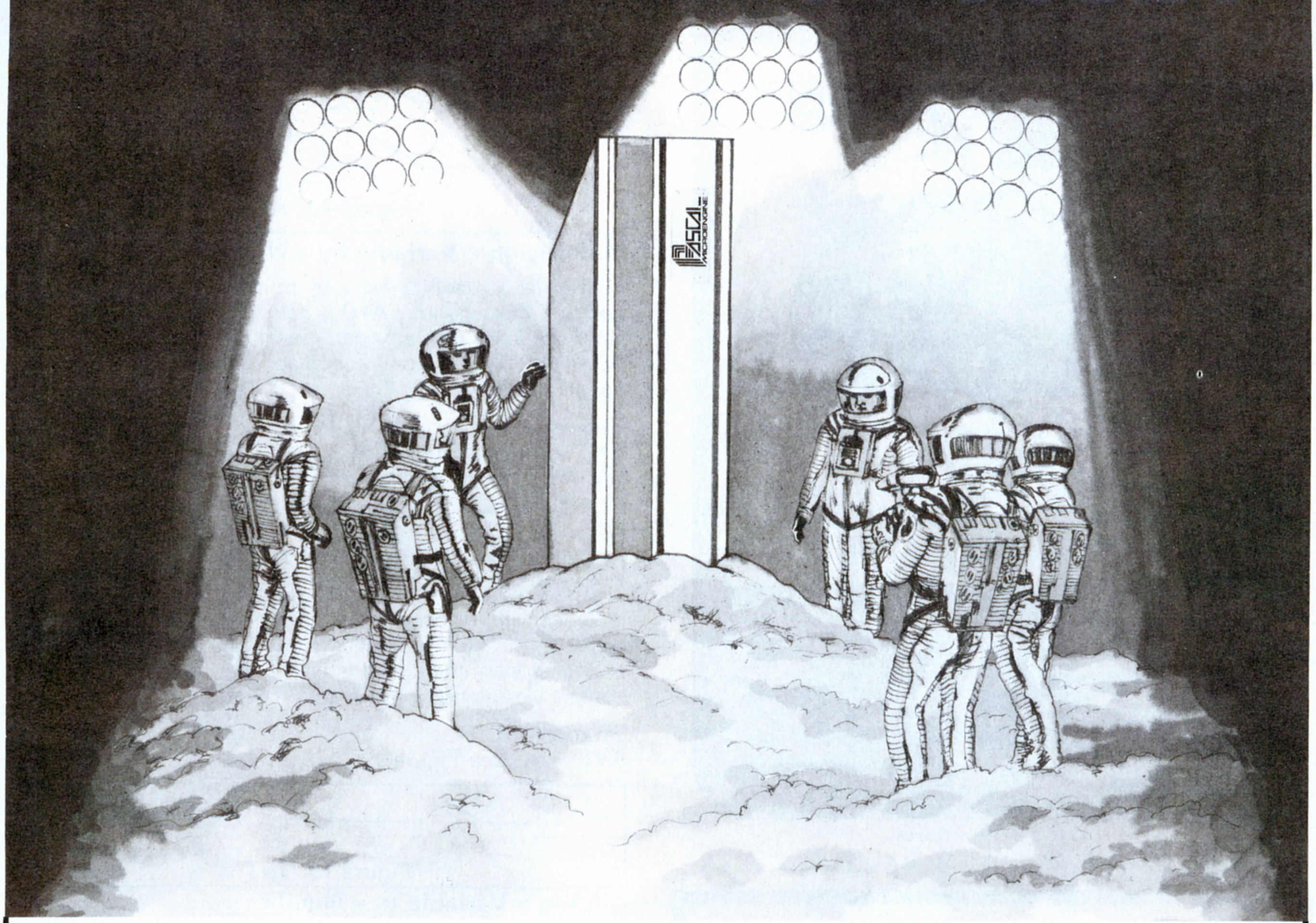
However, when the same variable is repeated twice, as in A•A, this is the same as if two contacts of the same relay were connected in series and which, therefore, close and open at the same time. The effect is the same as if only one contact was connected to the circuit. The same can be said for the expression A+A, since two contacts of the same relay connected in parallel act as a single contact. Therefore:

Theorem 5:
A•A = A (See Figure 72)

Theorem 6:
A+A = A (See Figure 73)

As you will notice, Boolean algebra is very simple; there are no coefficients and no exponents.

THE PASCAL ODYSSEY



WHAT'S SO GREAT ABOUT PASCAL?

The Pascal programming language is a *masterpiece* of human creativity. Originated by Niklaus Wirth at the Swiss Institute of Technology in 1968, Pascal was intended to aid in the teaching of *programming* as a *systematic discipline,* where the fundamental concepts of algorithms could be clearly and naturally expressed.

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Staff reporter Betsy Gilbert reports on what Fairchild is doing with today's technology to make American living better and safer.

To round out this special feature section, home applications for the 6800 are presented along with how games fit into the home environment.

To make this issue even more exciting, we have two in-depth hardware articles on CRT monitor design and interfacing a CRT. Plus the new tutorial, the PASCAL NOTEBOOK, by Associate Editor Henry Davis. It's a series you won't want to miss.

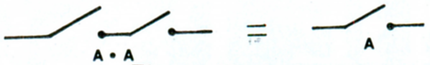

Figure 72. A•A = A

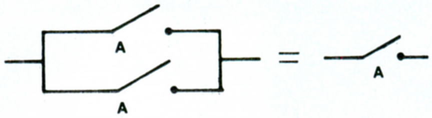

Figure 73. A + A = A

Multiplying a Variable by a Number

Now let's see the result of multiplying a variable by a number. For example, A•0 is equivalent to connecting contact A in series with an open circuit as shown in Figure 74. Whatever the position of contact A, the circuit is always open. Therefore:

Theorem 7:
A•0 = 0 (See Figure 74)

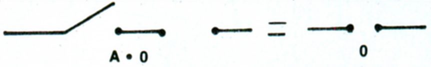

Figure 74. A•0 = 0

The expression A•1 is equivalent to connecting contact A in series with a closed circuit as shown in Figure 75. If contact A is "on" (closed) the circuit will be closed; if contact A is "off" (open) the circuit is open. So, the result is as if the contact was alone in the circuit. Therefore:

Theorem 8:
A•1 = A (See Figure 75)

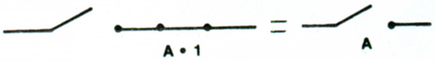

Figure 75. A•1 = A

Adding a Variable to a Number

Now, let's add a variable to a number. In this case, A+0 is equivalent to contact A connected in parallel with an open circuit, as shown in Figure 76, so:

Theorem 9:
A+0 = A (See Figure 76)

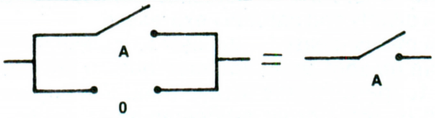

Figure 76. A+0 = A

The case of A+1 is more interesting. Here the connection of a closed circuit in parallel with a contact, as shown in Figure 77, makes this contact entirely useless, since current will flow through the closed branch regardless of the position of the switch. Therefore:

Theorem 10:
A+1=1 (See Figure 77)

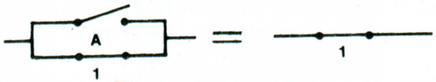

Figure 77. A+1 = 1

This latter theorem is very important. It is sometimes said that "one" absorbs all that is added to it.

COMPLEMENT RULES

Our next step wil be to study the concept of negation, inversion or complement in Boolean algebra. In its original logic form, Boolean algebra words have two concepts: true and false. However, the negation of a truth is the same as a falsity and, conversely, the negation of a falsity is the same as a truth.

Therefore, the negation or complement of one is zero, and the negation or complement of zero is one. In a circuit, negation, inversion or complement involves changing from an open circuit to a closed circuit, and vice versa.

A negation, inversion or complement is indicated by a line above the number or letter. Therefore, the complement rules are: $\overline{1} = 0$ $\overline{0} = 1$

Now suppose that we have variable A, which can assume the two conventional values, 1 and 0. The complement of this variable is $\overline{A}$ (not A) which represents a contact of the relay, then $\overline{A}$ is a back contact of the same relay. Therefore, whatever the condition of operation of the relay, when one contact is on, the other is off and vice versa.

If we combine in the same circuit both variables, A and $\overline{A}$, we find that A•$\overline{A}$ is equivalent to connecting a contact in series with its complement; and since one of these contacts will always be open when the other is closed, the circuit, as shown in Figure 78, will always be open. So:

Theorem 11:
$A \bullet \overline{A} = 0$ (See Figure 78)

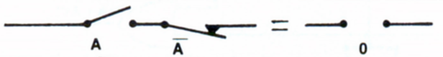

Figure 78. A•A = 0

A + $\overline{A}$, Figure 79, is equivalent to connecting a contact in parallel with its complement, and since one of the contacts will always be closed when the other is open, the circuit will always be closed. Therefore:

Theorem 12:
$A + \overline{A} = 1$ (See Figure 79)

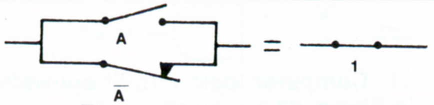

Figure 79. A + A = 1

This last expression is very important and should be kept in mind, since it is frequently employed as an auxiliary, as will be explained later in this lesson.

LOGIC APPROACH

Up to now, all the operational rules of Boolean algebra were deduced following an electrical point of view. We will analyze now the last mentioned expressions as logic propositions, so that we do not lose contact with logic.

Considering A as the proposition then $\overline{A}$ is its negation. So, if A is true, $\overline{A}$ is false, and vice versa. A•$\overline{A}$ is equivalent to a complex proposition in which it is simultaneously affirmed that A and $\overline{A}$ are true. Since this is impossible due to the nature of the complement, this affirming complex proposition must be false and, therefore, equal to zero. As an example, take the proposition: "X is a bird and X is not a bird." This proposition must be false whatever X is.

In the case of the relation A + $\overline{A}$, we have the following type of affirmation: "X is a bird or X is not a bird." This proposition is always true whatever X is.

DISTRIBUTIVE LAW

Continuing with our deductions, suppose that we have a circuit formed by three contacts: A(B+C), as shown in Figure 80. To flow through this circuit, the current must pass through contact A and then through contact B or contact C.

The same will happen with a circuit comprising four contacts: AB + AC. To flow, the current must pass through contact A then through contact B, or through contact A and through contact C.

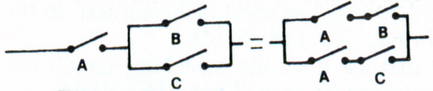

Figure 80. A(B + C) = AB + AC

From a functional point of view, both circuits shown in Figure 80 are equivalent; the only difference is that the first

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employs only one contact A and therefore is more economical than the second. The following theorem is called the Distributive Law.

Theorem 13:
$A(B+C)=AB+AC$

Note that when we changed from $A(B+C)$ to $AB+AC$ we performed an operation similar to that of multiplication in algebra. The inverse transformation from $AB + AC$ to $A(B + C)$, would be similar to that of the extraction of a common factor in algebra.

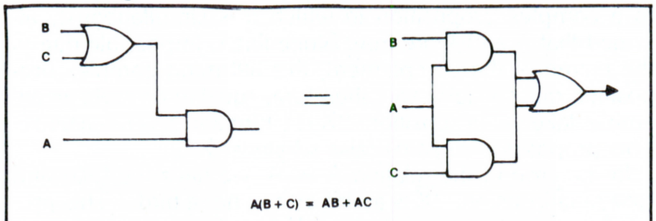

Figure 81. Transformation of a logic circuit to its equivalent.

In Figure 81 we show, in the form of logic computer block symbols, the difference between two *equivalent* circuits. Note how the configuration of the circuit changes from one "and" and one "or" circuit to two "ands" and one "or" circuit when the algebraic multiplication is performed.

TRANSFORMATION AND MINIMIZING OF CIRCUITS

Now, let us apply the theorems together with the basic rules of Boolean algebra previously learned to the transformation and minimizing of circuits.

Suppose that we have the switching circuit illustrated in Figure 82; its expression will be: $A(A+B)=S$.

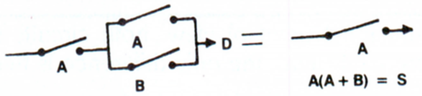

Figure 82. Minimizing a circuit.

Performing the indicated multiplication we obtain: $A(A+B) = AA + AB$.

But we know from Theorem 5 (Figure 72) that $AA=A$, and therefore $AA+AB=A+AB$ and factoring for A, we obtain $A + AB = A(1+B)$; but considering that $1+B=1$, then $A(1+B) = A \bullet 1$, and since $A \bullet 1 = A$ (Figure 75), we have found the following theorem:

Theorem 14:
$A(A+B)=A$

By means of these algebraic manipulations we have determined that the initial three-contact circuit is transformed first into a four-contact circuit $(AA+AB)$ which later was minimized to a single-contact circuit.

MINIMIZING COMPLEX EXPRESSIONS

A more complex expression, corresponding to the switching circuit illustrated in Figure 83, is expressed by the following equation. $(A+AD)\ (AC+B)=S$.

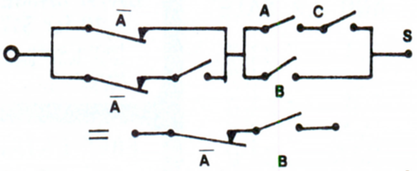

Figure 83. Simplification of a six-contact circuit to a two-contact circuit.

Multiplying, we obtain:

$$\begin{array}{l} \overline{A} \quad + \overline{A}D \\ \underline{AC + \quad B} \\ \overline{A}\,AC + \overline{A}\,DAC + \overline{A}B + \overline{A}DB \end{array}$$

The first and second terms of the product contain $\overline{A}A$ which, in accordance with Theorem 11 (Figure 78) is 0, so they may be eliminated. We have then the third and fourth terms left, from which we can extract the common factor AB, so: $\overline{A}B + \overline{A}DB = \overline{A}B\ (1+D)$

Since, according to Theorem 10 (Figure 77) $1+D=1$, we are left with: $\overline{A}B$.

We have thus reduced by means of algebraic operations, a circuit of six contacts to only two contacts as shown at the bottom of Figure 83.

In Figure 84 we present, with computer symbols, the circuit equivalent to the switching circuit of Figure 83. Note that the equivalent circuit consists of only an "and" circuit to which $\overline{A}$ and B signals must be applied simultaneously in order to obtain an output. Observe in illustration A of Figure 84 that this is true, since signals D and C are not present. Signals D and C by themselves have no effect on the circuit. So all the other "and" and "or" logic circuits are superfluous.

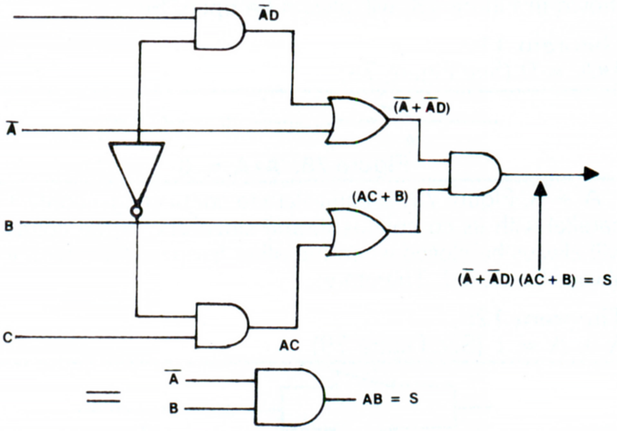

Figure 84. Computer logic circuit equivalent to that shown in Figure 83.

From a logic point of view, what we accomplished with the transformation is to clarify a proposition whose meaning was made obscure by the complicated manner in which it was expressed.

Another Example

Continuing with circuit examples, you will remember that in a previous discussion related with logic elements, we presented two forms to express the "exclusive or". The first was: $(A+C)\ (\overline{A}+\overline{C})$, while the second form was $\overline{A}C+A\overline{C}$.

The deduction was made following a descriptive pattern since, at that time, we did not know how to demonstrate their equivalence. We will present this mathematical demonstration now. First, we perform the indicated multiplication, term by term:

$$\begin{array}{l} A + C \\ \underline{\overline{A} + \overline{C}} \\ \overline{A}\,A + \overline{A}\,C + A\,\overline{C} + C\overline{C} \end{array}$$

The first and last terms are eliminated since they are equal to 0. Thus, we have demonstrated the equivalence between the two expressions: $(A+C)(\overline{A}+C) = \overline{A}\overline{C}+A\overline{C}$. For convenience, in order not to have to present the whole expression to indicate "exclusive or", the symbol $A \oplus B$ is sometimes employed.

DEMORGAN'S THEOREMS

I. "The complement or negation of a logic product is equal to the addition of the addition of the complements of the factors." In other words, in order not to satisfy a logic product, it is only necessary not to satisfy any of the conditions that comprise this product. $B = \overline{AB} = \overline{A}+\overline{B}$.

II. "The complement or negation of a logic addition is equal to the product of the complements of the addends." In

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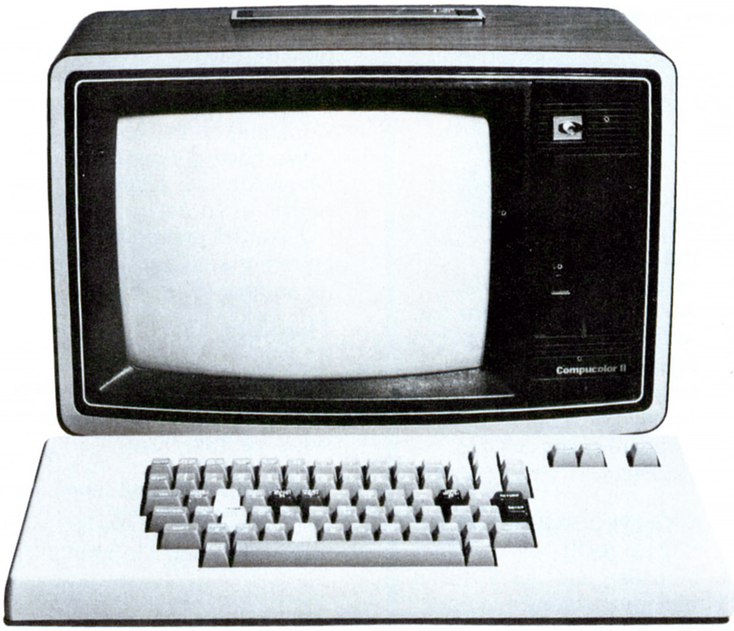

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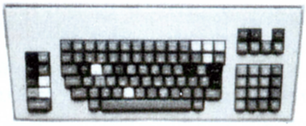

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other words, in order not to satisfy a logic addition, it is necessary not to satisfy simultaneously both of its components. B = A+C = AC.

Operational Rules

From De Morgan's theorems, we can derive the following general rule: "To invert or complement an expression in Boolean algebra it is only necessary to invert all of its components and to change all the multiplication signs to addition signs and all the addition signs to multiplication signs."

We have determined then that there is a great affinity between the two relations, "and" and "or". This affinity will permit us to derive some new operational rules.

Take the expression A+BC. It is evident that if we invert an expression and later reinvert it, the expression maintains its original value. That is,

Theorem 15:

$\overline{\overline{A}} = A$

If we invert the expression A+BC twice, which we indicate by placing another line on top of the complemented expression, we then have:

$$A+BC = \overline{\overline{A+BC}}$$

Performing the first inversion we obtain:

$$A+BC = \overline{\overline{A}\bullet(\overline{B} + \overline{C})}$$

and performing the multiplication:

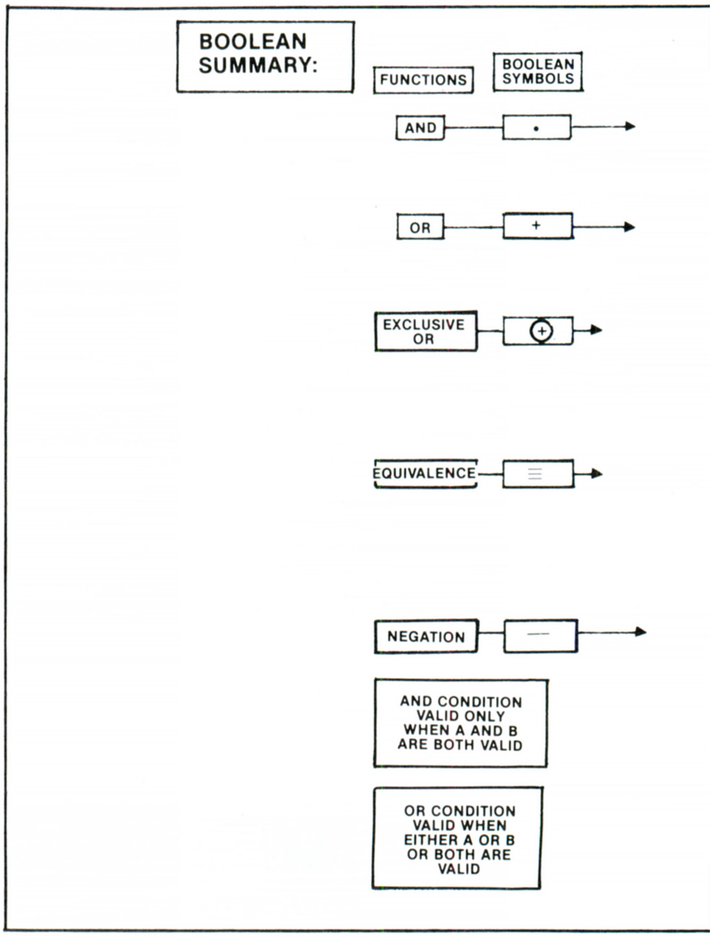
$$A + B = \overline{\overline{A}\,\overline{B} + \overline{A}\,\overline{C}}$$

and making the second inversion we find the following theorem:

Theorem 16:

$(A+B)\,(A+C) = A+BC$

As you have noticed, we have inverted an expression and, after having converted by this means its additions to multiplications, we performed the multiplication term by term. Once the operation was performed, we reinverted it, changing again multiplications to additions.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OR CONDITION VALID WHEN EITHER A OR B OR BOTH ARE VALID

But what is more important to note by examining Theorem 16 is that, in Boolean algebra, it is not only possible to multiply term by term, but also to add factor to factor. This is so because by a simple inversion, multiplication is changed to addition and vice versa; and all the operational rules that are derived for one, can also be applied to the other.

Theorem 17

An expression composed by two addends of the type: $A+AB$ is always reduced to the first addend. The algebraic reduction is very simple; we simply extract the common factor: $A+B = A(1+B)$. But since according to Theorem 10, $1+B$ is equal to 1, then: $A(1+B) = A(1) = A$, and therefore Theorem 17 is: $A + AB = A$.

The formula in a logic proposition would be the same as to say: "To be able to vote, you must be over 18 or you must be over 18 and be a university student." It is logic to see that any person who is over 18 and is a university student more than satisfies the conditions, since with only being over 18 he can vote. So, the last condition is entirely redundant.

Theorem 18

An expression of the type $A+\overline{A}B$ is also reduced very easily. We add factor to factor and the first addend to the second, thus: $A + \overline{A}B = (A + \overline{A})(A + B)$. But since according to Theorem 12: $A + \overline{A} = 1$ (Figure 79), then:

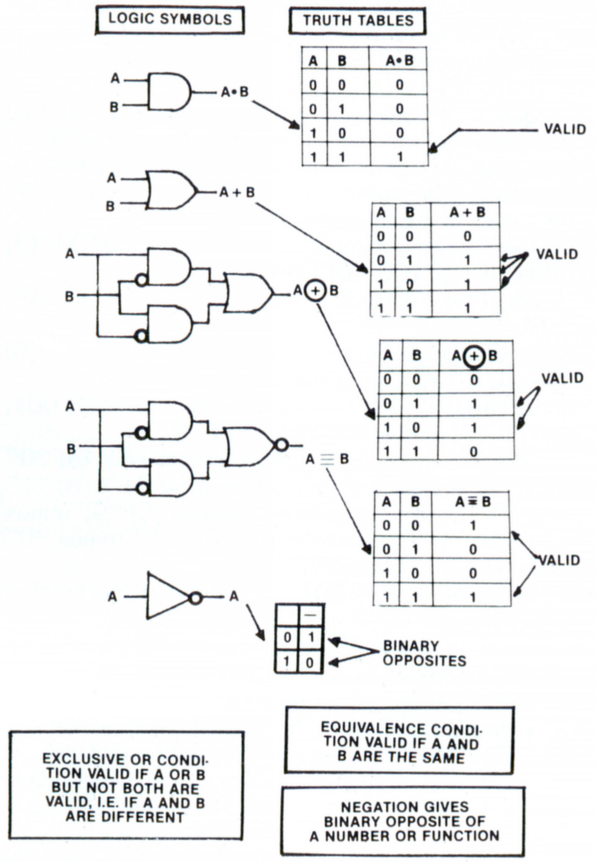
$A+\overline{A}B = 1\,(A + B) = A + B$

Theorem 18: $A + \overline{A}B = A + B$

Setting this formula up as a logic proposition would be the same as to say: "Alfred ate the pie or Benjamin ate the pie, and not Alfred." The logic result is that either Alfred or Benjamin ate the pie.

TABLE OF BOOLEAN ALGEBRA THEOREMS

In the following table, we present all the theorems of Boolean algebra previously studied. By referring to this table it is easier to remember the basic principles studied, and to apply them to the solution of problems.



A	B	A•B
0	0	0
0	1	0
1	0	0
1	1	1

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

A	B	A≡B
0	0	1
0	1	0
1	0	0
1	1	1

	—
0	1
1	0

EXCLUSIVE OR CONDITION VALID IF A OR B BUT NOT BOTH ARE VALID, I.E. IF A AND B ARE DIFFERENT

EQUIVALENCE CONDITION VALID IF A AND B ARE THE SAME

NEGATION GIVES BINARY OPPOSITE OF A NUMBER OR FUNCTION

Figure 85. The five basic Boolean operations.

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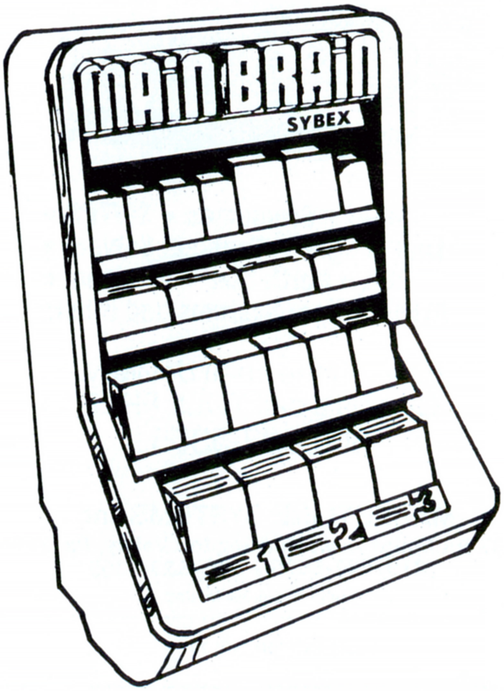

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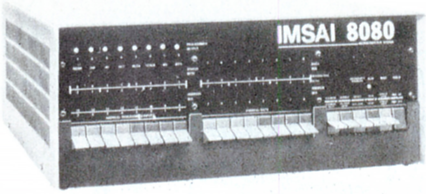

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SORRY

You have probably noticed that Programming Technique Night 5 did not appear in this month's issue. This in-depth programming tutorial has been temporarily suspended until the September issue.

With the September issue, Programming Technique will resume with Night 5. This hiatus is important because it gives us and Bill Turner the chance to correctly evaluate the many responses we have had toward the tutorial.

When the series resumes, Bill will be equating the assembly coding techniques to the BASIC language coding techniques. We have found from the numerous letters sent to us that many of the readers would like to see this approach, since they feel that it would help in the understanding of the art of computer programming as it relates to the micro world. Because the purpose of the tutorial is to assist you, the reader, this approach will be taken.

So stand by and look for Programming Technique Night 5 in the September issue.

Table 13. Boolean Algebra Theorems

1. $A \bullet B = B \bullet A$
2. $A + B = B + A$
3. $A(B \bullet C) = (A \bullet B)C$
4. $A + (B + C) = (A + B) + C$
5. $A \bullet A = A$
6. $A + A = A$
7. $A \bullet 0 = 0$
8. $A \bullet 1 = A$
9. $A + 0 = A$
10. $A + 1 = 1$
11. $A \bullet \overline{A} = 0$
12. $A + \overline{A} = 1$
13. $A(B + C) = AB + AC$
14. $A(A + B) = A$
15. $\overline{\overline{A}} = A$
16. $(A + B)(A + C) = A + BC$
17. $A + AB = A$
18. $A + \overline{A}B = A + B$

NEXT MONTH

Due to space limitations, Minimization By Karnaugh Maps was not covered in this tutorial. A brief overview on Karnaugh Maps will be given in Unit Four. In Unit Four subjects such as logic circuits, IC concepts and logic families will be introduced.☐

UNIT THREE SUMMARY/QUIZ

1. When applying Boolean algebra to an electrical circuit (A) a notion of "true" corresponds to an open circuit; (B) a closed circuit is considered as having a value of "0" and an open circuit is considered as having a value of "1"; (C) a closed circuit is considered as having a value of "1" and an open circuit is considered as having a value of "0"; (D) a notion of "false" corresponds to a closed circuit; (E) the power should be "on".
2. Binary number 11110 equals decimal number (A) 18; (B) 8; (C) 30; (D) 23; (E) 32.
3. Convert 101011010110_2 to hexadecimal; (A) $10\ 13\ 6_{16}$; (B) $3\ 9\ F_{16}$; (C) 63_8; (D) $83C_{10}$; (E) $AD6_{16}$.
4. In applying Boolean algebra to relay type switching circuits, an expression of the type $A \bullet B$ corresponds to (A) a contact of relay A connected in parallel with a contact of relay B; (B) a contact of relay A connected in series with a contact of relay B; (C) the front contact of relay A connected to the back contact of relay B; (D) the back contact of relay A connected to the front contact of relay B; (E) a combination of logic circuits.
5. In Boolean algebra, the word "OR" is expressed by (A) the plus sign; (B) the multiplication sign; (C) the minus sign; (D) the division sign; (E) the percent sign.
6. Decimal number 17 equals binary number (A) 10001; (B) 1010; (C) 1011; (D) 100010; (E) 10100.
7. A negation, inversion or complement is indicated by (A) a line under the number or letter; (B) a parenthesis; (C) an addition sign in front of the number or letter; (D) a line above the number or letter; (E) a multiplication sign ahead of the number or letter.
8. The two's complement of 01001 is (A) 00100; (B) 10001; (C) 11100; (D) 00000; (E) 10111.
9. 1 is equal to: (A) $A+0$; (B) $A+1$; (C) $A+A$; (D) AA; (E) $1A$.
10. $\overline{A+B+C}$ is logically equivalent to: (A) $\overline{A}+\overline{B}+\overline{C}$; (B) $A(\overline{B+C})$; (C) $\overline{ABC}$; (D) $\overline{A}\ \overline{B}\ \overline{C}$; (E) $A+B+C$.
11. Subtracting 011_2 from 110_2, the difference is (A) 001; (B) 011; (C) 1001; (D) 101; (E) 010.
12. According to the rules for binary subtraction, (A) "0" minus "1" equals "1" with a borrow of "1"; (B) "1" minus "1" equals "1" with no borrow; (C) "0" minus "1" equals "1" with no borrow; (D) "1" minus "0" equals "1" with borrow of "1".
13. The binary number 11001 is equal to decimal number (A) 12; (B) 20; (C) 25; (D) 32; (E) 43.
14. The equation $\overline{A}C + A\overline{C} = E$ applies to (A) an OR circuit; (B) an AND circuit; (C) an exclusive OR circuit; (D) a NOT circuit; (E) an inverter.
15. An expression composed by two addends of the type $A + AB$ (A) is never reduced to the first addend; (B) cannot be reduced to the first addend; (C) is redundant; (D) is very difficult to reduce; (E) is always reduced to the first addend.
16. Please rate the third unit of the NTS mini-series: (A) very good; (B) good; (C) average; (D) poor.

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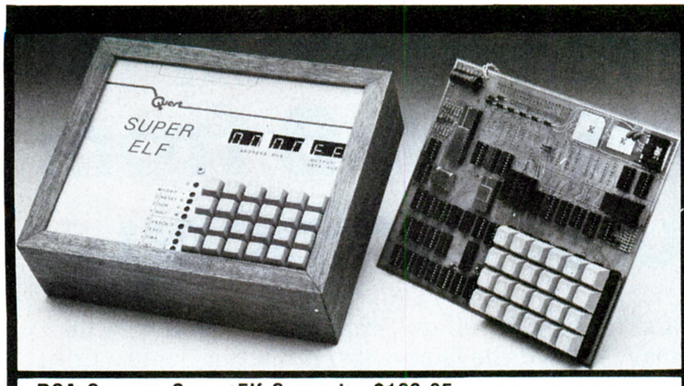

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A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector for PC cards and a 50 pin connector for the **Quest Super Expansion Board**. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95. NiCad Battery Memory Saver Kit $6.95.** All kits and options also come completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic for ANY 1802 System

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CIRCLE INQUIRY NO. 78

DOUBLE DENSITY RECORDING ON FLOPPY DISKS

A Comparison of Techniques

By Jefferson H. Harman
Director of Research and Development
PerSci, Inc.

INTRODUCTION

In the continuing search for more data storage for less money, the computer system designer is making use of double density codes on floppy disks. The use of these codes, which alter the way "ones and zeros" are electronically recorded on the media, doubles the capacity of the floppy disk, almost for free. There are catches, however. All double density encoding methods are more susceptible to noise and density effects than the single density codes. Therefore, the design engineer should have a complete understanding of techniques before embarking on a double density program.

MECHANIZATION OF RECORDING

In order to understand why simply changing the code can double system capacity, the reader should know something of what happens in saturated magnetic recording. The read-write head of a recording device consists of a coil on a ferromagnetic core. This core has a gap of non-magnetic material which is brought into contact with the media. (Or very near the media in flying head hard disks.) Current in the coil magnetizes the media as it passes under the gap.

The coil responds to a *change* in the magnetic flux of the media. This is accomplished by moving the media. In addition to motion, a change in the magnetic field from the disk is required to produce an output. In other words, the read head can only detect where transitions in polarity occur. Therefore, the information must be encoded in the location of these transitions, and the read system must operate by locating these transitions. This is done by detecting the peaks of the read signal.

SELF CLOCKING CODES

The simplest code is to write a transition for each one, and no transition for each zero. This is NRZ. This code is very efficient, having only one bit per transition. Unfortunately, NRZ does not contain a clock, which is necessary in order to know the time in relation to the code. If a code is serial (such as in floppy disks), the data rate has small changes due to speed variations. Unless a clock is provided, it can't be determined how many successive zeros have occurred between ones. In systems where several tracks are read in parallel, schemes guaranteeing at least one transition on one of the tracks (usually also checking parity) can be used to clock the code — as in seven or nine track tape drives. This code is not used in floppy disks because only one track at a time is read.

Double frequency code, also known as FM, frequency doubling, and other aliases, consists of adding a clock to NRZ such that the data transitions are ideally centered between clocks. This code is self clocking, is easy to encode and decode, but requires two transitions per bit. It is the most widely used single density code for floppy disks.

DENSITY EFFECTS

If one could write magnetic flux reversals as close together as needed, then requiring two transitions per bit would be no disadvantage. However, life isn't that simple. As transitions are packed closer together on the media, density effects begin to shift the location of the transitions. This shift interferes with the ability to distinguish clock from data, and is the limiting factor on capacity. Of course, single density floppy disks are operated at the practical maximum for FM recording.

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Since the floppy disk is a disk, the density changes from inner to outer tracks. Density is highest at track 76 with 6400 transitions per inch and lowest at track 00, with 3600 transitions per inch. At high density the output level is lowest, and peak shift greatest. At low density the output stays near zero for relatively long periods, producing inflection points that, with the addition of noise, could erroneously be detected as peaks.

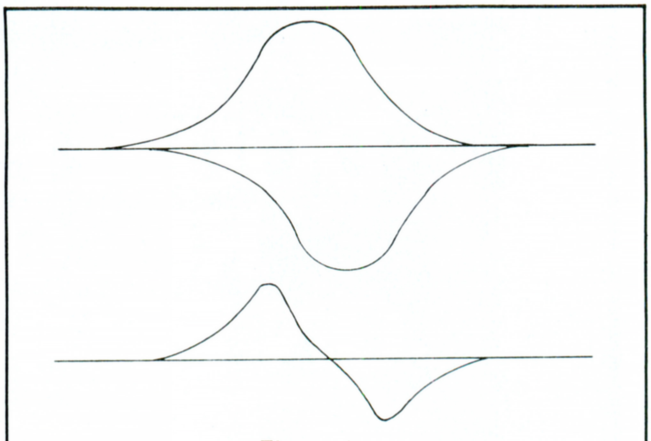

Figure 1.

Peak shift has two causes. The first is density effects which cause peaks to shift apart. Pulses which are close tend to move away from each other when bounded by pulses which are not so close. In FM or MFM, this effect can be as great as 300 ns. Density effects can be reduced be precompensation, a purposeful distortion of the pulse pattern to compensate for the peak shifts known to occur. The second cause of peak shift is asymmetry, which is due to poor write circuits, poor read circuits, or poor head design. Read and write circuits can be made essentially symmetrical by careful design and selection of components, but heads can be expected to produce ±100 ns of asymmetry.

In order for a code to be more efficient, it must reduce the transition rate required to transmit data from two transitions per bit to anything less than two transitions, while at the same time providing clock information. Three codes: MFM, M^2FM, and 4 for 5 GCR have been successfully used to double the capacity of floppy disk drives. This has been done at little hardware cost and with good reliability, However, systems using double density codes are more susceptible to problems from system noise, dirty heads, worn diskettes, and speed variations than FM systems.

```
DATA        1       0       1       1       0       1
NRZ         1               1       1               1
FM      1   1   1       1   1   1   1   1       1   1   1
MFM         1               1       1               1
M²FM        1               1       1               1

DATA        1   0   1   1   0   1   1   1   0   0   0
MFM         1       1   1       1   1   1     1   1   1
M²FM        1       1   1       1   1   1     1       1
DATA        1   0   0   0   1   0   0   0   0   0   0
MFM         1     1   1     1     1   1   1   1   1
M²FM        1     1         1     1       1       1
```

Figure 2.

MODIFIED FREQUENCY MODULATION (MFM)

MFM is the oldest of these codes. MFM adds a clock to NRZ, much like in FM. However, the clocks are only added between successive zeros. Since the highest frequency in FM occurs when clocks are inserted between successive ones, The maximum transition rate is half that of FM for the same data rate. The minimum frequency in MFM would be half the frequency for FM at the same data rate. Therefore, doubling the data rate would not increase the transition rate over FM.

Although MFM data at 500 KHz requires no higher transition rate than FM at 250 KHz, the time window for determining if a transition is clock or data is half that of FM. The practical window is the theoretical window minus the peak shift effects and speed variation. The theoretical window for MFM at 500 KHz is 1 μs peak to peak. Peak shift can be 600 ns peak to peak due to pulse crowding, plus 200 peak to peak due to asymmetry. This leaves 200 ns. Speed variation can take another 50 ns, another 50 ns for the ability of the phase locked loop to track the data, another 10 ns for variations in logic delays, another 40 ns for noise; and the window has gone to zero for MFM — although FM at half the data rate still has 1 μs to spare.

Practical MFM systems use some form of write precompensation to reduce the effect of peak shift. Practical margins of ±100 ns are obtained in this manner. Error rates far less than 1 soft read error in 10^9 bits have been demonstrated.

MFM recording, in fact all of the double density codes to be considered, must be synchronized with a phased locked loop. This is because some of the clock pulses are missing. FM, of course, can be synchronized with a one shot. However, even with FM a phased lock loop gives demonstrably better data reliability.

MODIFIED MODIFIED FREQUENCY MODULATION (M^2FM)

In order to improve the margins of MFM it was modified; hence M^2FM. The modification was to add clock pulses between successive zeros only if a clock was not inserted between the previous successive zeros. In this manner a clock pulse is never crowded. However, the longest time between pulses has increased to 5 us for a 500 KHz data rate.

Since the clock pulses are not crowded, peak shift on clock pulses will be less than on data pulses. The decoding window can be widened for data and narrowed for clock. This will increase the margin by the amount the window is skewed. Use of write precompensation distorts this. With the write precompensation used at PerSci, it was found that M^2FM worked best with a symmetrical window and worked as well but no better than MFM. The longer time between pulses would appear to make M^2FM more susceptible to noise at outside tracks, but this has not been a practical problem.

Precompensation Required	WRITE PRECOMPENSATION MFM or M^2FM	Encoded MFM/M^2FM Bit being Compensated
300 nsec to right		0 0 0 1 0 1 0
300 nsec to right		0 0 0 1 0 0 1
100 nsec to right		1 0 0 1 0 1 0
300 nsec to left		0 1 0 1 0 0 0
300 nsec to left		1 0 0 1 0 0 0
100 nsec to left		0 1 0 1 0 0 1

Figure 3.

GROUP CODED RECORDING (GCR)

The third method of doubling diskette capacity through a code is 4 for 5 GCR. This approaches the problem from an entirely different perspective.

If five bits of code are used to encode four bits of data, then those patterns containing long strings of successive zeros may be eliminated. Practical codes having no more than two successive zeros are in use on floppy disk drives and on tape. The code bits occur at 1.25 times the data rate, hence this is a 1.25 transition per bit code instead of a one transition per bit code.

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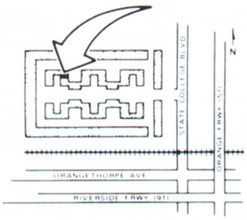

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0001	11011
0010	10010
0011	10011
0100	11101
0101	10101
0110	10110
0111	10111
1000	11010
1001	01001
1010	01010
1011	01011
1100	11110
1101	01101
1110	01110
1111	01111

Figure 4.

The minimum time between transitions in GCR is 1.6 µs, the maximum is 4.8 µs. GCR code is not quite as bad as M²FM for shouldering effects at track 00. Peak shift due to pulse crowding is worse than MFM or M²FM since pulses only 1.6 µs apart are bounded by pulses 4.8 µs apart. However, the ideal window is 1.6 µs wide, so GCR is much more tolerant of peak shift. Practical windows of 400 ns have been achieved without write precompensation. With write precompensation this improves to 600 ns.

WRITE PRECOMPENSATION

Write precompensation consists of examining data to be written and shifting the transition in time in a direction to compensate for expected peak shift. The precompensation may be made as elaborate as the controller designer desires. The more accurate the compensation the better the timing margins.

PerSci recommends compensating six patterns of encoded MFM or M²FM. Four of the patterns require 300 ns of compensation, and two of the patterns require 100 ns.

Encoding GCR simply requires grouping data into 4-bit "nibbles" and via a ROM, matrix, or whatever, translating it into corresponding 5-bit code groups. Decoding consists of translating the code groups into corresponding data nibbles. A code group, usually all ones, is reserved for synchronization.

SUMMARY

Double density recording can be reliably accomplished with all of these techniques. The final choice of which is to be used in a system is usually decided by such factors as desirability of interchange with a company which is using one of the methods already; IBM compatibility; availability of an off the shelf controller; availability of LSI controller chips; or such factors as management prejudice and customer preference.

And, while all of the double density techniques work, the reader should remember that drives and diskettes must be maintained cleaner and in better condition than with FM, that most tolerant of codes.☐

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Proposed American National Standard Recorded Magnetic Tape for Information Interchange (6250 CPI, Group Coded Recording)

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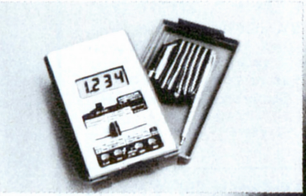

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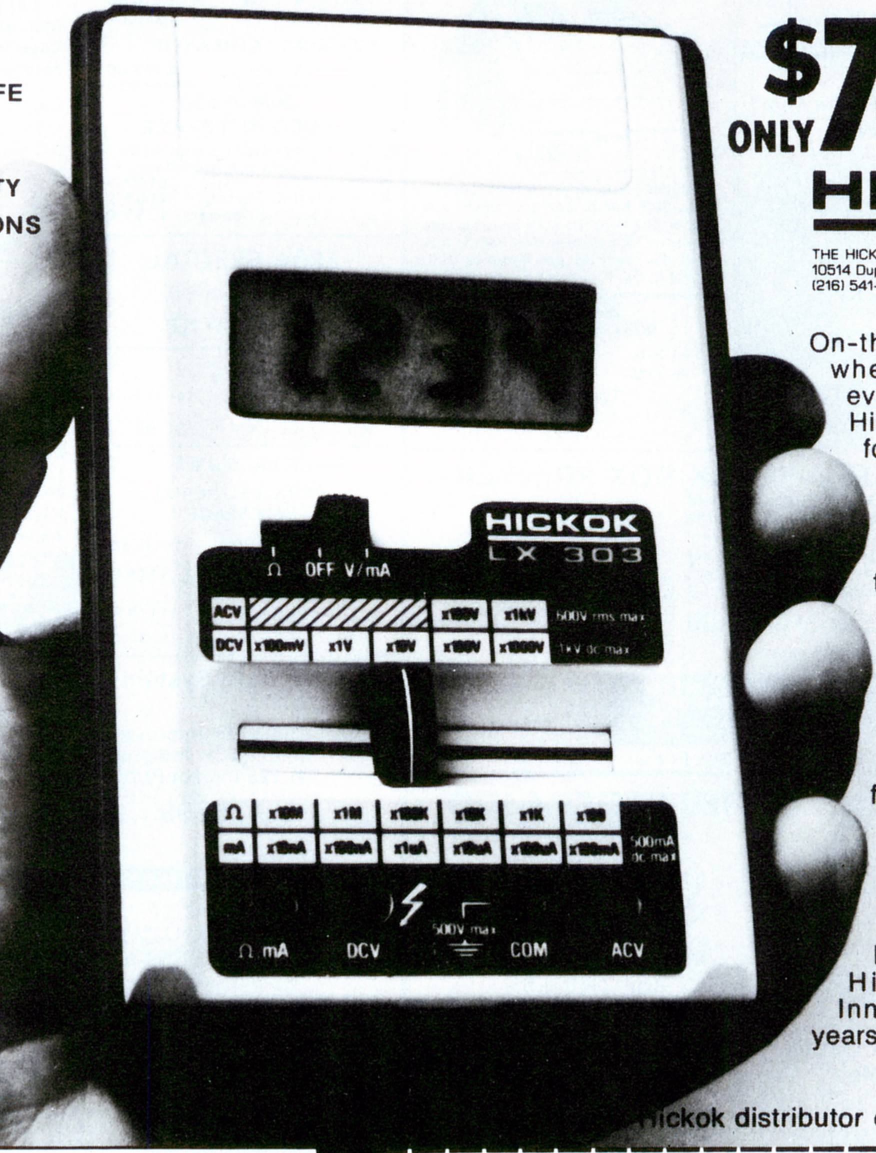

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SPECIFICATIONS:
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AC VOLTS (40Hz to 5kHz): 0.1V to 600V; Accuracy: ±1.0% rdg ±0.5% f.s. (−2dB max. at 5kHz); Max. input: 600V.
RESISTANCE (6 LOW POWER RANGES): 0.1Ω to 20MΩ; Accuracy: ±0.5% rdg ±0.5% f.s. (±1.5% rdg on 20MΩ range); input protected to 120VAC all ranges.
DC CURRENT (6 RANGES):.01nA to 100mA; Accuracy: ±1.0% rdg ±0.5% f.s.
DIMENSIONS AND WEIGHT: 5-7/8" x 3-3/8" x 1-3/4", 12 oz.; POWER: 9V batt. (not incl.) or Hickok AC adapter; READ RATE: 3/sec. OPERATING TEMPERATURE: 0°-50°C.

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1791 BO1
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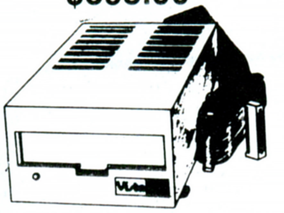

Includes disk drive, power supply, regulator board, compact case, and cabel. The V-80 offer 23% more storage capacity. Simply take it out of the box and it's ready to go! Requires 16K, Level II, EX. R.

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4MHz CPU Chip

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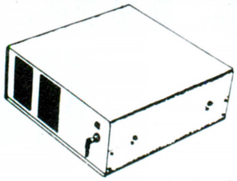

Accomodates all S—100 Mother Boards. Built-in card cage with card guides. Lighted reset switch. Rotron whisper fan. Includes heavy duty power supply. (+ 8 volts DC @ 30 AMPS, + 16 volts DC @ 4 AMPS, -8 volts DC may be added.

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Soft sector, 10 sector, or 16 sector
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JADE FLOPPY DISK (Tarbell board)

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Kit	$159.95
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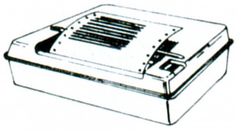
EXPANDOR'S BLACK BOX PRINTER

This 64-character ASCII impact printer with 80-column capability is portable and uses standard 8½" paper and regular typewriter ribbon. Base, cover and parallel interface are included. Assembled and complete with manual and documentation. **only $470.00**



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TRS-80 Interface Cable for Black Box Printer with mating connectors: **$48.00**
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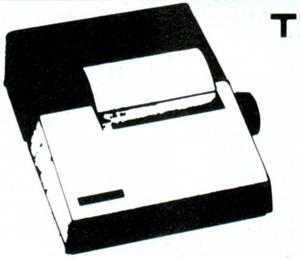

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- 96 character set
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Check the impressive features on Integral's IP-125 Impact Printer

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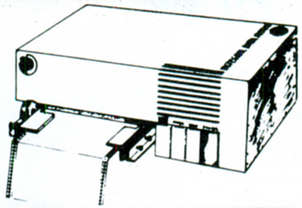

LOADED WITH EXTRAS AT NO EXTRA COST

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IP-225 Integral Data System IP-225 Tractor Feed Printer
- All standard features of IP-125
- Tractor feed paper drive
- Forms Control Option (P1250)

$949

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- 96 upper & lower case ASCII character set
- Enhanced character control
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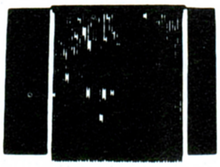
- Parallel TTL Interface (factory wired on req.)
- 80 column line
- 256 byte multiline buffer

$799



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3690 6.5" 22/4 pin. 156 ctrs. Extenders $12.00

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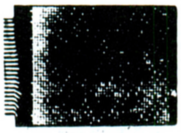
8800V

Universal Microcomputer/processor plugboard. Use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16".

8801-1

Same as 8800V except plain, less power buses & heat sink.

	1-4	5-9	10-24
8800V	**19.95**	**17.95**	**15.96**
8801-1	**14.95**	**13.46**	**11.96**



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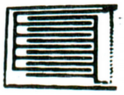

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8228	$ 6.40
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KIT: $249.00
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■ This controler utilizes the proven reliability of the IBM standard format as well as the lastest phase-locked-loop for data seperation. ■ All clocks are generated from an on-board cyrstal oscillator ■ Right precompensation is used to enhanced data recovery reliability in the double density mode ■ Density selection is enitirely transparent to the user ■ Single and double density diskettes can be mixed on the same system.

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IMPROVED DESIGN AND FEATURES

- ON BOARD 2708 or 2716 EPROM
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4116's

Everything a person needs to add 16K of memory. Chips come neatly packaged with easy to follow directions. In minutes your machine is ready for games and more advanced software.

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A KIM-1 compatible machine with on-board printer and a real keyboard!

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Special Package Price: $599.00
AIM-65 (4K), Power Supply, Case, and 8K BASIC ROM

New Prices

DYNAMIC RAM BOARDS EXPANDABLE TO 64K

32K VERSION • KITS

Uses 4115 (8Kx1, 250ns) Dynamic RAM's, can be expanded in 8K increments up to 32K:

8K	$159.00	24K	$249.00
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4115 SALE
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■ 80 character by 24 line format (Model 57) ■ Completely self contained terminal electronics, just add CCTV monitor and key board ■ No support software required ■ Switch selectable modes: Half Duplex, Full Duplex, Block mode ■ Block mode allows for editing before transmit ■ Keyboard interface provided ■ Fully assembled, socketed, tested, burned in, and guaranteed for a full year from date of purchase ■ Video is switch selectable "Black-on-White" or "White-on-Black"

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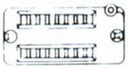

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16 pin Zip Dip II	$5.50
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Soldertail	$3.25 each
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Wire Wrap	$4.00 each
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★ STATIC RAM ★ SPECIALS

2114's, low power (1024x4)	1-15	16-99	100 +
450ns	8.00	6.95	5.50
300ns	9.00	8.00	6.50
TMS4044/MM5257, low power			
450ns	8.00	7.50	6.50
300ns	9.95	8.75	8.00
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410D (4K x 1, 200 ns)	8.25	7.00	6.75

STATIC RAM BOARDS

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Kits:	450ns	$125.95
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	250ns	$169.75
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Assembled & Tested:		
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	RAM 65B (450ns)	$350.00
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Assembled & Tested:		
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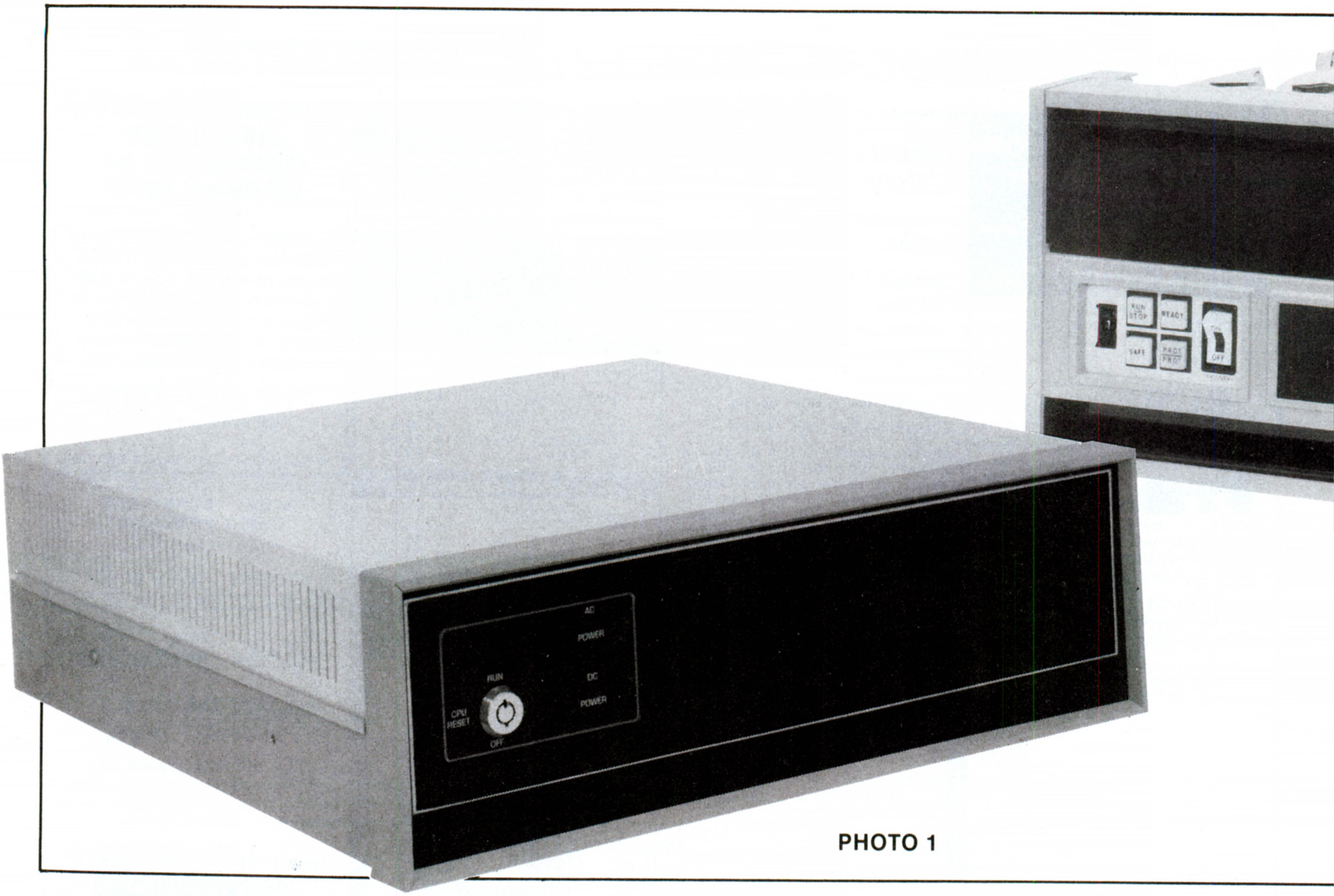
AC
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DC
POWER
RUN
CPU
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OFF
RUN
STOP
READY
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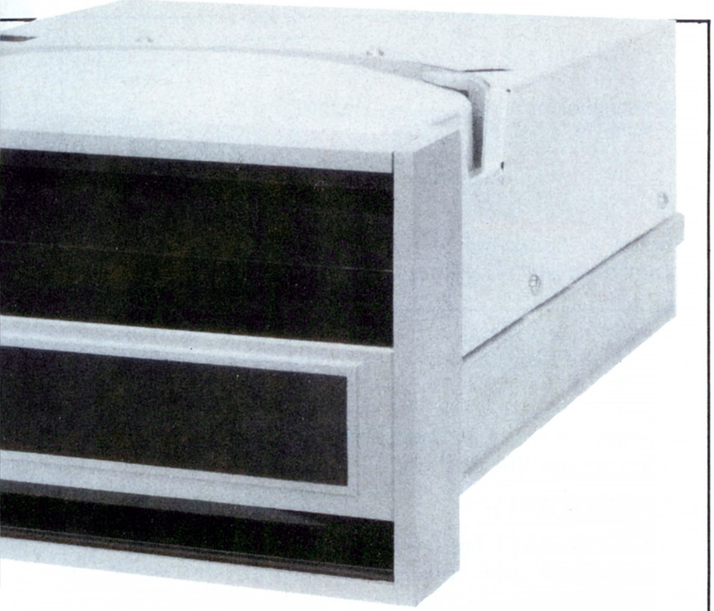
PHOTO 1

MAXIMIZING THE

The iCOM 4511 10-Megabyte

PHOTO 2



DP EFFORT:
Hard Disk System

By Tom Fox, Systems Editor

A major difficulty that has existed in the development of business data processing systems has been the inadequacy of mass storage systems. Businesses by their nature amass large amounts of information — data — that is used in the day-to-day operation.

Unfortunately, even with double density recording techniques, not all the necessary data will physically fit on 5.25-inch or 8-inch floppy disks. This necessitates having either multiple drives or frequently changing the media.

There is, however, an alternative available to the systems designer to overcome this difficulty; *hard disk technology.*

WHAT IS A HARD DISK?

A hard disk, as the name implies, is a non-flexible storage medium. The actual media is usually composed of an aluminum platter coated with ferric oxide (Figure 1). The aluminum platter is designed with speed and balance in mind, allowing extremely high rotation of the platter. The ferric oxide coating is the substrate upon which magnetic data is recorded.

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by the Research Staff of Essex Publishing
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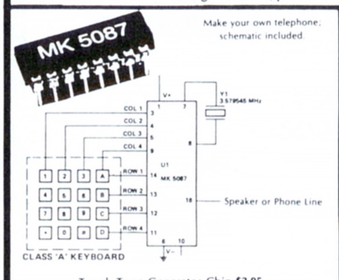
Z80 A 4 MHZ CPU $14.80
F8 CPU 3850 $9.95 P10 3871 $9.95 SM1-3853 $9.95

100 pcs Price: 5087 – $2.60 Z80 CPU – $6.85 P10 or CTC – $4.96 16K Ram Mostek 250 NSEC – $5.73

Z80 Programming Manual – 300 pages, detailed explanation each instruction $6.50
F8-3870 Programming Manual – 300 pages on F8 programming $6.50
Z80 Data Book – Hardward manuals on Z80 CPU, P10, CTC, SID, DMA plus application notes $3.50
F80-3870 Data Book – Hardware manuals on F8 CPU, P10, DMI, SMI, PSU and 3870, 3872, 3876 plus applications notes $3.50

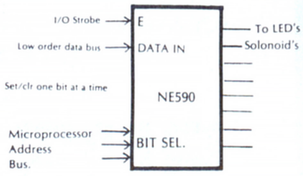
FREE: *WITH EVERY ORDER: 31 page pocket Z80 MICRO-REFERENCE MANUAL*
FREE: *with every order for the 5087 telephone tone generator chip; a telecommunications data book data sheets on tone generators, pulse dialers, repetory dialers, codec chip and applications*

Make your own telephone; schematic included.



Touch Tone Generator Chip **$3.95**

16 pin OCTAL LATCH/250 ma Driver
PIN and functionally compatible with **74259 and 9334**



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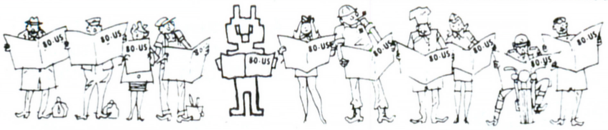

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CIRCLE INQUIRY NO. 58

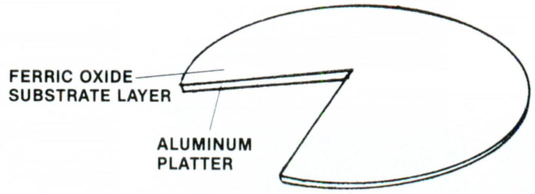

Figure 1. Cutaway view of physical hard disk showing aluminum platter vehicle and ferric oxide substrate.

In hard disk systems there are: fixed platter or cartridges, meaning the disk cannot be removed from the drive, and removable platters or cartridges, or a combination of both, in one system. Utilizing both the fixed and removable concepts in one system provides greater storage capability and allows for transporting the database.

THE iCOM 4511

The iCOM 4511 hard disk system utilizes both the fixed and removable disk concepts, which provides up to 10 million characters of storage on one disk unit. Each disk contains up to 5 million characters.

The 4511, which has been available for two years, is designed for the S-100 bus microcomputer systems. The unit (Photo 1) consists of the Pertec D3422 drive and 88-HDSK Data Keeper Controller.

The controller is bus oriented with a five slot motherboard. The system is delivered with three plug-in boards: a processor board which handles the overall control of the disk system, a data disk board that handles the disk housekeeping tasks, and the disk interface board that provides communication to and from the disk unit.

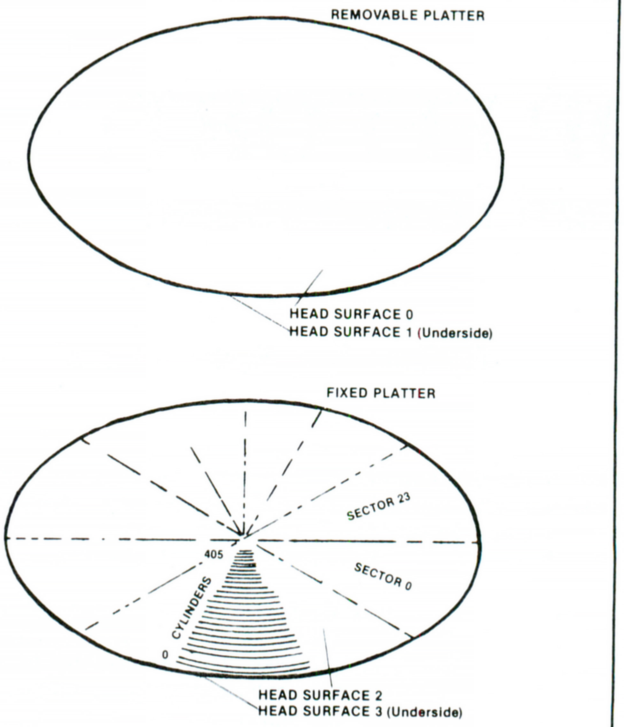

Figure 2. Platters for D3422 Drive. (Provided courtesy of Pertec)

The system is designed to interface directly with the S-100 bus computer through two parallel I/O ports. The D3000 type drive has one fixed platter and one top loading 5440 type removable platter (Photo 2). The platters rotate at 2400 rpm, with a bit density of 2200 bits per inch, providing a data transfer rate of 2.5Mbits per second.

Because of the unique design of the 88-HDSK controller, up to four drives may be daisy chained on one system. Also the 4511 can be configured in a system that is simultaneously supporting floppy disks, without causing interference. This flexibility in design makes it possible for users who have software on a floppy system to maximize their systems by effecting storage system changeover without losing any time or capability.

UNDERSTANDING THE STORAGE CONCEPT

The iCOM disk unit is able to provide 10 million bytes of storage by treating each disk as two surfaces. Figure 2 shows the general layout of each physical platter. Each platter, as shown in the figure, has two head surfaces. Each surface is divided into 24 sectors. Each sector contains 406 cylinders or possible radial positions of the head assembly.

The head assembly floats approximately 100 microinches above the surface of the platter and never touches the media. Due to the high rotational speed of the platter and the floating heads, the unit is sensitive to dust, dirt and smoke, all of which can cause a head crash. Figure 3 is an example of the sensitive nature of the mechanism. The point is that any hard disk system is a high technology device and is not designed to be moved around or mistreated.

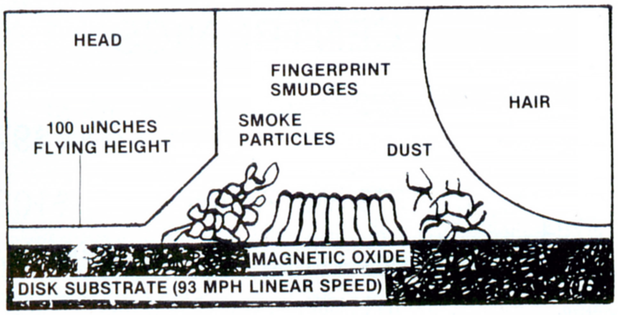
HEAD
100 uINCHES FLYING HEIGHT
FINGERPRINT SMUDGES
SMOKE PARTICLES
DUST
HAIR
MAGNETIC OXIDE
DISK SUBSTRATE (93 MPH LINEAR SPEED)

Figure 3. Head Sensitivity. (Provided courtesy of Pertec)

SOFTWARE

The 4511 system comes equipped with a special version of Altair extended BASIC, and CP/M. Both are provided on a 5440 type cartridge. Bootstrap loader PROMs are included to provide fast system initialization.

CP/M was chosen in July of 1978 as the operating system due to its popularity and flexibility of system integration. CP/M treats the hard disk like a tremendous floppy, which means that it can be used as a main system control for a floppy/hard disk configured system.

COST AND SUPPORT

The iCOM hard disk sells in the $10,000 range for a 10 megabyte system. This includes the drive, controller, system software, and documentation. Also included in the price is two years of field tested hard disk experience, and Pertec's product support.

Pertec dealers have the experience and training to provide minimal maintenance on the system. Pertec also has available a maintenance contract through Sorbus, a nationwide service organization, to provide preventative and critical maintenance for the units.

According to company officials, Pertec's emphasis is on ensuring both dealer and end user satisfaction. This they feel comes about through well-engineered product design and customer support.☐

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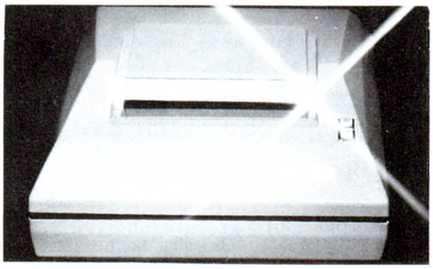

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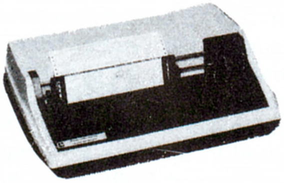

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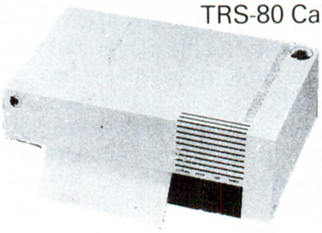

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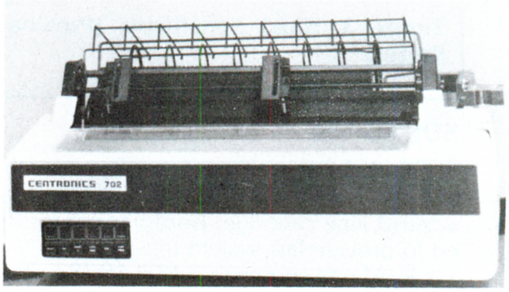

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CIRCLE INQUIRY NO. 74

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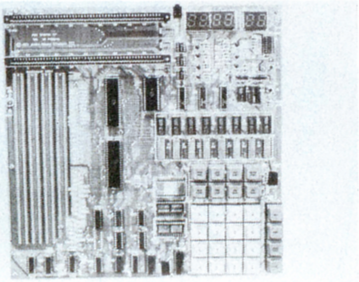
NEW PRODUCTS

MICROCOMPUTERS

Z-80 Starter Kit

SD Systems announces its new Z-80 Starter Kit. The unit is designed for kit assembly by students, experimenters and OEMs evaluating the Z-80 microprocessor. Training school applications have been particularly addressed in the comprehensive training and assembly manual.

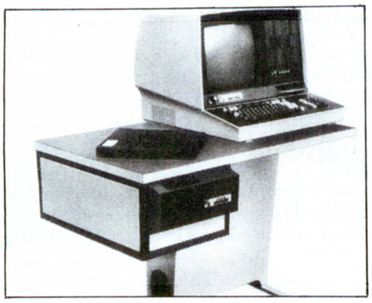


Includes a Z-80 microprocessor, 1K bytes of RAM; 2K ZBUG monitor in ROM; 4-channel counter/timer; sockets for 4K PROM; 2 bidirectional 8-bit I/O ports; 28-key keyboard and more. Price is $249. For more information contact Bob Arata, (800) 527-3460.

CIRCLE INQUIRY NO. 122

CP/M for Micral C

The R2E Micral C small business microcomputer system is now compatible with the CP/M operating system, offering double-density minifloppy drives and an optional 10/80 megabyte disk system with removable media.

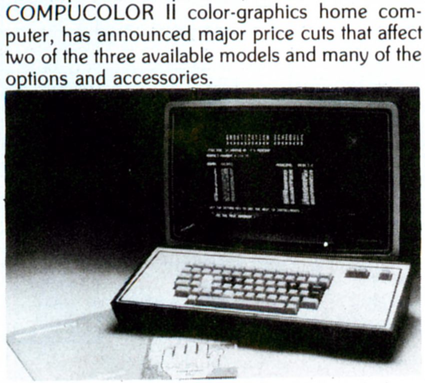


The Micral C with CP/M compatibility offers the user dynamic allocation of disk storage on floppies or hard disk, plus all the standard features of CP/M. Price for a Micral C with dual double-density floppies, 32K of RAM, 1920-character CRT display, keyboard and CP/M is $8995. For details contact R2E of America, 47 Bedford St., S.E., Minneapolis, MN 55414, (612) 378-7060.

CIRCLE INQUIRY NO. 124

Compucolor Cuts Prices

Compucolor Corporation, manufacturer of the COMPUCOLOR II color-graphics home computer, has announced major price cuts that affect two of the three available models and many of the options and accessories.



The Compucolor II Model 4, which includes a 13-inch 8-color CRT, a built-in minifloppy disk drive and Extended Disk BASIC in ROM has been reduced from $1,795 to $1,695. The Model 5, with 32K of memory, has been reduced from $2,395 to $1,995. For information contact Susan Sheridan, Compucolor Corp., P.O. Box 569, Norcross, GA 30071, (404) 449-5879.

CIRCLE INQUIRY NO. 125

More Powerful Interact Model One

Interact Electronics has doubled the maximum memory capacity of its Model One home computer. With the new 16K RAM and the new extended BASIC, Model One users may now write larger, more complex BASIC programs for more powerful scientific, business, personal and entertainment applications.

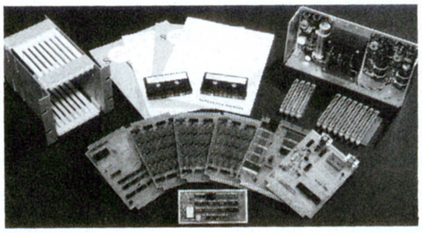
Price is $599.95. Included with the computer, which is FCC-approved for home use, is a library of 13 pre-programmed cassettes which provide a wide range of programming, educational and entertainment capabilities for the entire family.

For more information contact Interact Electronics, P.O. Box 8140, Ann Arbor, MI 48107.

CIRCLE INQUIRY NO. 127

Low Cost 6800 Development System

Wintek's new Development Pac II includes 48K RAM and an EROM programmer for $1895. Also included is an RS-232 serial I/O port with switch selectable baud rates, 300 baud and 2400 baud cassette interfaces, an editor/assembler, and industrial BASIC, and all other items required to configure a 48K development system. For details contact Wintek Corp., 902 N. 9th St., Lafayette, IN 47904; (317) 742-6802.



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The M203 mark II computer is an inexpensive computer for the user who does not require expandability in his system. To process large quantities of business data, use it as the system terminal of a large computer or make technical computations based on large quantities of data.

The standard M203 mark II contains 64K bytes internal memory, 350K bytes minifloppy disk drive, 12" CRT display, full ASCII keyboard with 10-key pad and special purpose keys, power supply affordable up to 2 drives, two RS232C interfaces for printer and communications.

For details contact Sord, 8300 N.E. Underground Dr., Kansas City, MO 64161, Bob Chambers, (800) 821-5436.

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76 short practical programs, most of which can be used on any microcomputer with any version of BASIC. Complete with program descriptions, listings, remarks and examples. 200 pages. #06-3 $8.50†

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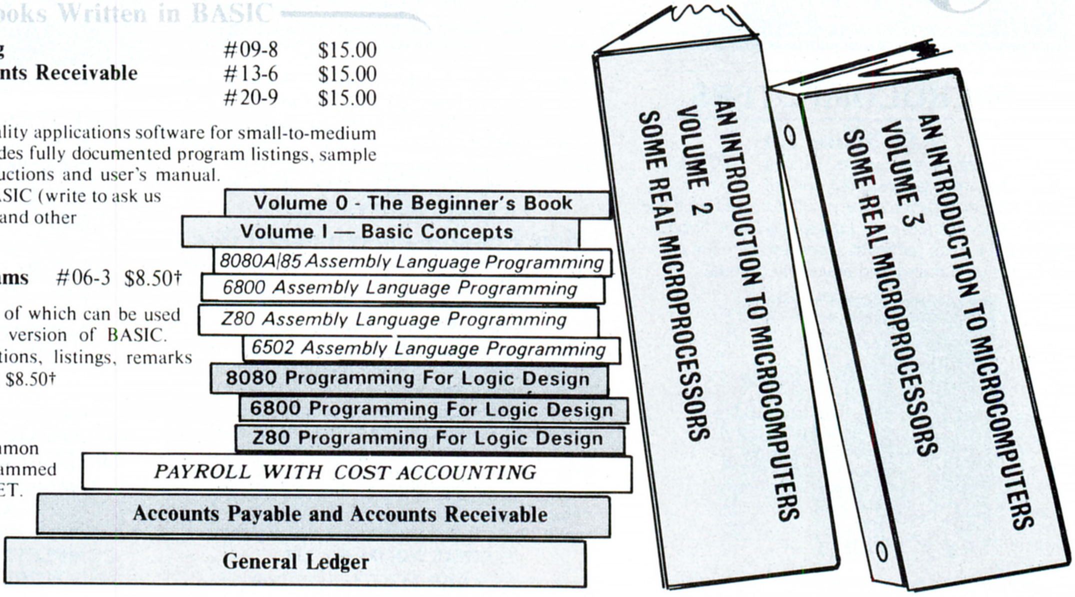
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A must for anyone in the computer field, this best selling text explains hardware and programming concepts common to all microprocessors. Its universal appeal is reflected by its having the greatest yearly sales volume of any computer text. 350 pages. #02-2 $8.50†

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Provides objective, commercial-free descriptions of virtually every microprocessor on the market today. Lets you know what's available, how they work (or sometimes don't work), and how to use them. More detailed user/designer information than provided by most manufacturers.

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Same objective, in-depth coverage as Volume 2, but applied to support devices that might be used in any microprocessor system: memory, data communication devices, data converters, direct memory access controllers, busses, and much more.

*Volume 2 and Volume 3 Updates

To cope with the rapid evolution of microprocessor products, Volumes 2 and 3 have their own series of six bimonthly updates, allowing you to remain current with all parts as soon as they are really available. Update subscriptions sold separately.

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Volume 3 binder #19-5	$ 5.00
Volume 2 update only	$25.00/yr.
Volume 3 update only	$25.00/yr.
Volume 2 and 3 updates	$40.00/yr.

†As of July 1, 1979 all $8.50 book prices increase to $9.50. If ordering after July 1, 1979 please use $9.50 price.

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troller slot of the OP-1 terminal. The software used to program PROMs with the board does not depend on which of the four controller slots it is plugged into. Usually, it is convenient to plug the programmer into slot 7, leaving controller slots 8 for hard disk, 9 for diskette, and 10 for printer.

The UPP is similar in dimensions to a standard controller with the exception of its length. It extends out of the card cage and allows access to the PROM sockets without the power down of the terminal and the removal of the card. The PROM programmer uses the internal power supply of the terminal and needs no external power supplies or connections of any kind.

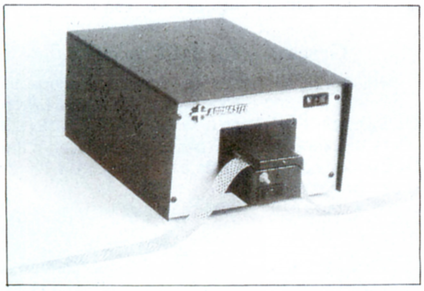
The hardware has been designed for both Intel and Texas Instruments versions of the 2716 EPROM. It also has the capability of programming the 2732 and 2764 when these PROMs become available.

For more information and pricing contact Nelma Electronics Limited, 1707 Sismet Rd., Unit 9, Mississauga, Ontario, Canada L4W 2K8.

CIRCLE INQUIRY NO. 136

RS-232C Computer Compatible Paper Tape Reader

Addmaster Corporation announces that the Model 612 Stand Alone Paper Tape Reader is now available from stock and is shipped in 1 to 3 working days after receipt of order. The Model 612 has greater capacity than earlier models.



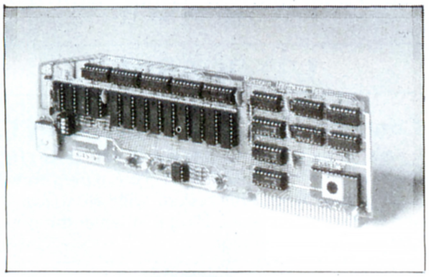
The ability to read 5 to 8-level tape and to transmit 7 to 11 frames per character at 50 to 9600 baud are among the new features. RS 232 current loop or parallel outputs are available.

Desk top or rack mounting. Single unit prices from $625 to $761. For details contact Addmaster Corp., 416 Junipero Dr., San Gabriel, CA 91766, (213) 285q1121.

CIRCLE INQUIRY NO. 137

THE APPLE CLOCK

Mountain Hardware has a Real-Time Calendar/Clock for Apple II computers. The Apple Clock keeps time and data in lms increments continuously for over one year. Calendar, clock, and event timer functions are easily accessed from BASIC using routines carried in on-board ROM.



Crystal controlled for accuracy. An interrupt feature is provided which can be programmed to make efficient use of computer time.

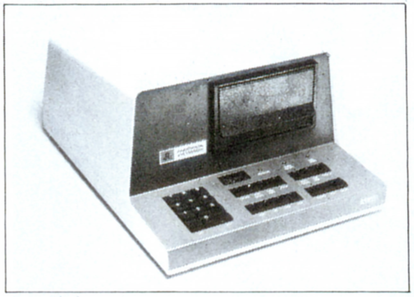
Price is $199 assembled and tested. Delivery is stock to 30 days. For information contact Mountain Hardware, Inc., 200 Harvey West Blvd., Santa Cruz, CA 95060, (408) 429-8600.

CIRCLE INQUIRY NO. 138

DISKS

AJ 460 Micro Diskette System

The AJ 460 is a communications storage device that uses a 5¼-inch minifloppy disk for storing and preparing information. Designed to be an efficient replacement for paper tape, cassette or mag card units, the AJ 460 offers the user advantages of faster transmission rates, split speed for slower terminals, instant line addressing, longer media life and high data reliability.



Price for one is $1995. For information contact Anderson Jacobson, Inc., 521 Charcot Ave., San Jose, CA 95131, (408) 263-8520.

CIRCLE INQUIRY NO. 140

Gunn Utility Disk

Cromemco owners can handle disk directories and files easier and faster with the 11 utilities on the Gunn Utility Disk No. 1. This new machine language utility package, used with CDOS, permits doing things with Cromemco systems that were impossible before.

The new Gunn utilities include: alphabetize diskette directories; create .CMD files from directory to allow transferring or outputting selected file groups; isolate bad diskette clusters into bad-cluster directory; recover/display erased directory entries; map on console or printer the diskette clusters occupied by all or any selected file or group of files; permit jumping to and executing programs at a HEX addres; provide current date (month, day of month, year) for easy use by any program with file access capability; automatically eject diskette from selected drive(s) when desired.

All eleven major utilities are provided on a single minifloppy or 8 inch diskette along with a clear instruction manual that helps the user enjoy added operating ease immediately.

Price is $95, available from computer stores or from the distributor, Comput-R-Ware, Div. Ken Kirkpatrick Advertising Inc., 7910 Westglen, Houston, TX 77063.

CIRCLE INQUIRY NO. 141

Floppy Disk Controller

The FD-100-STD is for users of STD Bus Z-80 microprocessor systems. The FD-100, which is physically and electrically compatible with the new Pro-Log/Mostek STD bus concept, will support up to four IBM standard format soft-sectored floppy disks, in either 8" or 5¼" size.

The software controllable flexibility of the FD-100 allows intermixing of both types of drives. A motor ON/OFF control circuit for minifloppies is provided as a standard feature.

The controller incorporates a Z-80 PIO circuit and will fully support Mode 2 interrupt-structured software. I/O port selection is mini-switch selectable.

Single quantity price is $215. OEM discounts available. For more information contact Applied Micro Technology, P.O. Box 3042, Tucson, AZ 85702, (602) 795-9929.

CIRCLE INQUIRY NO. 142

TERMINALS

Graphic Display Board

The PBM-1 is a memory-mapped alphanumeric and graphics display board for the SS50 bus. Built around the Motorola MC6845 CRT controller integrated circuit, the board provides the following features: programmability via the processor bus; on-board screen memory in 1K increments up to 4K; programmable cursor with various formats; on-board I/O port for keyboard, printer, joystick, etc.; upper case, lower case and

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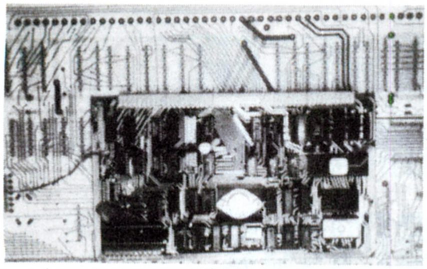
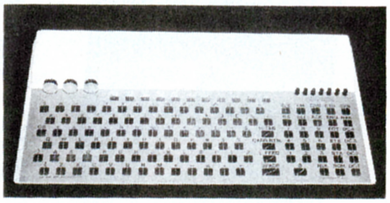


graphics characters available simultaneously, and much more. For details contact F & D Associates, 1210 Todd Rd., New Plymouth, OH 45654.

CIRCLE INQUIRY NO. 144

Capacitive Touch Keyboard

Star Devices manufactures a low cost data input terminal for microprocessors. The features of the standard unit include 7 bit parallel ASCII encoded output with positive and negative strobe edges; full ASCII character set; auto repeat; audio feedback; low profile plastic case; requires 5 volts at 200 mA. Options include serial RS 232 output; 20 mA current loop; parity check bit; on-board 5 volt regulator; open collector outputs active high or low.



For more information contact Star Devices Limited, P.O. Box 21, Newbury, Berks, U.K.

CIRCLE INQUIRY NO. 148

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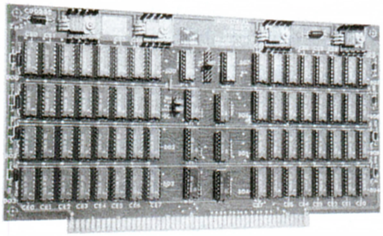
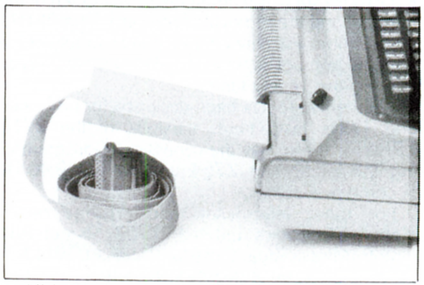
CIRCLE INQUIRY NO. 64



PRINTERS

TRS-80 Modular Printer Interface

The TRS-80 Print Module plugs directly into the back of the Radio Shack Computer (keyboard) and eliminates the need for the Expansion Interface when driving such printers as Centronics, Telpar and Axium.



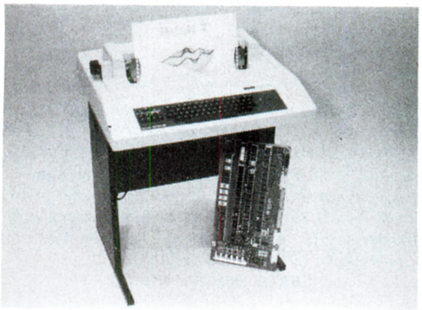
All line print commands in Level II BASIC are compatible and, because the module draws power from the printer, the TRS-80 remains completely unaffected by the interface.

Price is $99.95. Delivery stock to 3 weeks. For details contact American Micro Products, 6550 Tarnef, M/S 11, Houston, TX 77074, (713) 777-2759, Bill McNeil.

CIRCLE INQUIRY NO. 150

Graphics for DECwriters

Selanar Corporation is now shipping its GRAPHICS II add-on feature for LA35 and LA36 DECwriters. For either new or old DECwriters it offers significant added performance, using the DECwriter console driver and provides a handshake protocol.



Graphics II key features include graphics output, APL, Math Symbol sets; International sets, special symbols; Boldface, double width and rotations; horizontal and vertical tabs, form feed; 1200 baud, 1000 character buffer.

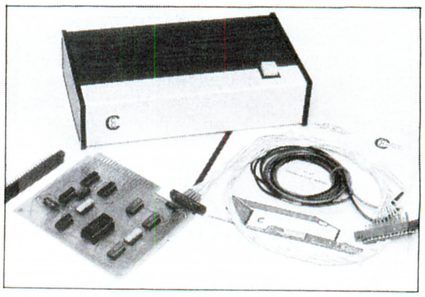
Price is $850. Delivery is 60 days. For details contact Selanar Corporation, (408) 737-2777.

CIRCLE INQUIRY NO. 151

I/O BOARDS

Control System for TRS-80 and PET

Able to sense up to 24 inputs and drive 16 medium power outputs, the SY-16 is a plug compatible turnkey control system with all software and hardware furnished. Plug it in, enter the program and start operation.



The 16 output devices can be any 6 volt or less ON/OFF mechanism using less than ¼ ampere.

MANAGE

NATURAL LANGUAGE DATA BASE MANAGER
FOR THE ALPHA MICRO SYSTEM

Allows processing of files by sentences written in English, rather than by programs written in a computer language. For example, you may ask the computer to "List prospects whose interest is houses and whose price is between $60,000 and $90,000 by Zip Code as labels".

Definitional capability allows easy categorization of records into terms meaningful to the user. For example, telling the computer "DEF: Pasadena Residents: Mailing whose Zip Code is between 91101 and 91108 but not 91102" would allow subsequent processing using only the words "Pasadena Residents" to refer to that group. User defined terms are unlimited in form, length and number.

Help messages are available throughout the system for user convenience. By simply entering a question mark, at any time, the system will respond with a message specifying the type of input MANAGE is expecting. Dual question marks will print the message in greater detail. Triple question marks will display a complete, menu driven user's manual.

Other special features include: user defined, unlimited length fields; access from user programs via command files; passwords; background processing; and flexible output formatting.

A new approach to memory management optimizes the mapping of data, and the loading of programs, for maximum operating speed in the amount of memory available in the user's system. This is done automatically, and is transparent to the user. Thus thousands of records can be stored, ordered, categorized and otherwise processed in a matter of seconds, rather than in minutes or hours. Practical applications include:

- Mailing lists
- Market analysis
- Inventory files
- Personnel files
- Customer listing
- Buyer's Guide
- Budget Analysis
- Price lists
- Real Estate listings
- Quality Control Records
- Telephone directory
- Reservation system
- Mail order management
- Library cross indexing
- Appointment scheduling
- Employment agency files

A ready-to-use disk, with complete user's manual, is priced at $1250. A demonstration disk, with a maximum capacity of 90 records, is available for $100. Manual only, $5.00. Enhanced versions, as they become available, will be available to all users for a copying charge of $25.00, including revised manual.

The Byte Shop of Lawndale offers complete, turn-key systems with Video terminal, High speed printer, 48K memory, and a 10 Megabyte hard disk drive at prices starting at $15,750.

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CIRCLE INQUIRY NO. 61

Input devices can be TTL gates, or any form of switch contacts.

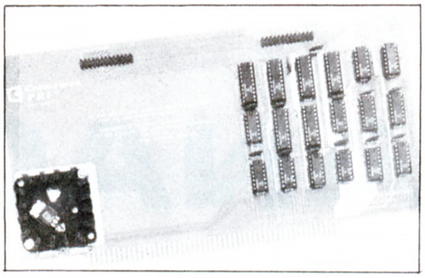
Price is $289 assembled. For for information contact Cooper Computing, Box 16082, Clayton, MO 63105.

CIRCLE INQUIRY NO. 153

Printer Interface Card

Cromemco's new printer interface (PRI) card makes it easy to interface either dot-matrix or daisy-wheel printers to a computer system. The PRI card is designed with two actual interfaces. One uses the "Centronics parallel" convention and interfaces with Cromemco Model 3779 or 3703 dot-matrix printers. The second interface uses the "daisy-wheel parallel" convention and interfaces with Cromemco Model 3355 daisy-wheel printer.

The second interface has built-in ribbon-life and ribbon-lowering circuitry to free the software overhead normally required for this function.



Price is $195 factory assembled. Cables available in two lengths. 62 cm (Model CBL-2) for $15; and 110 cm (Model CBL-3) for $15. For information contact Cromemco, Inc., 280 Bernardo Ave., Mountain View, CA 94043, (415) 964-7400.

CIRCLE INQUIRY NO. 155

TRS-80

PERIPHERALS & SUPPLIES

DISK DRIVES $399.00

Fully compatible with Radio Shack drives. **Includes:** ■ Power supply ■ case (specify silver or blue) ■ 4 drive connector cable ■ verbatim diskette with test program and user op. system ■ 60 day warranty ■ complete user instructions.

16K RAM SETS $106.00

200NS 16K Dynamic RAM Memory Kit. NEC chips. Includes jumpers and instructions for installing in TRS-80 keyboard unit or expansion interface. (Specify keyboard or interface.)

VERBATIM DISKETTES $3.30 ea. 10 FOR $30.00

These are the top of the line in diskettes and worth every cent of the $6.00 each that you pay elsewhere.

CENTRONICS-779 LINE PRINTER $1200.00

With forms tractor. This is the same printer that Radio Shack supplies. A 399.00 savings if you buy from us.

TI-810 PRINTER $1995.00

All set to run on your TRS-80 at twice the speed of the 779.

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For fast service or information call (714) 894-3736

CIRCLE INQUIRY NO. 77

MEMORY BOARDS

Price Reduction on Multibus Memory

Mupro Corporation has reduced prices on its serie sof 16K memory boards, which are multibus compatible. The MBC-016 16Kx8 standard memory board has been reduced from $985 to $795.

The MBC-016P 16Kx8 memory board featuring parity to detect memory errors has been reduced from $1050 to $850.

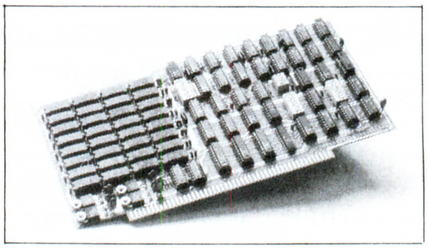
The MBC-016C 16Kx8 memory board featuring full error checking and correction (ECC) for 85 times more reliability has been reduced from $1395 to $1175. The MBC-016C also features LED indicators which pinpoint any failing memory chip, enabling easier field servicing.

For more information contact Mupro Corp., 424 Oakmead Pkwy., Sunnyvale, CA 94086, (408) 737-0500.

CIRCLE INQUIRY NO. 161

64K Byte Dynamic RAM Board

SupeRam, manufactured by Piiceon, Inc., of San Jose, California and marketed by Alpha Micro is completely compatible with the 16-bit Alpha AM-100 CPU.



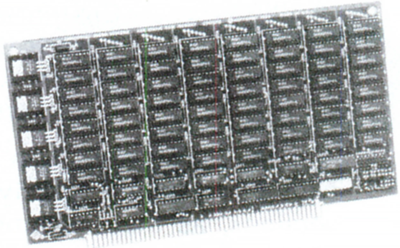
SupeRam is a high-density random access memory board capable of storing up to 65,536 bytes of data on a single board. Completely S-100 bus compatible, it utilizes 16K dynamic RAMs to achieve maximum bit density, minimum power dissipation and optimum cost/performance ratio.

Available for immediate shipment. For further details contact Alpha Micro, 17881 Skypark North, Irvine, CA 92714, (714) 957-1404.

CIRCLE INQUIRY NO. 162

New Memory Board

The Model 370 is a 32 Kbyte static RAM board that operates on the S-100 bus. The design, manufacturing and testing are done to industrial standards.



The board's starting address can be selected at 4K boundaries. Memory mapping capability is included so that more than 64 Kbytes of memory can be utilized in a system. Processor Write or Memory Write signals can be selected for writing data into memory, and the Phantom Line capability is included.

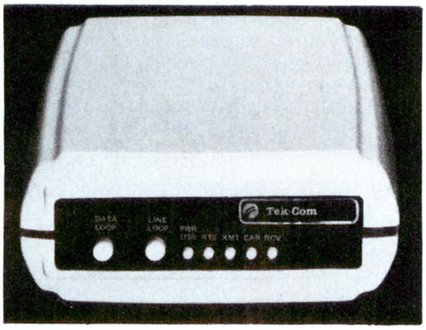
For more information contact Industrial Micro Systems, 628 N. Eckhoff St., Orange, CA 92668, (714) 633-0355, Murray Shackelford.

CIRCLE INQUIRY NO. 163

MODEMS

Leased Line, 1200 Baud Modem

TEK-COM's TC5001 modem has been designed to optimize the transfer of medium-speed data over unconditioned lines. The TC5001 offers a full set of test functions and diagnostic indicators for ease of installation and system troubleshooting.



Specific design and operational features include: 0 to 1200 baud asynchronous data rate; 0 to 1800 baud over C-2 conditioned lines (option); half/full duplex; point-to-point or multipoint polling and addressing; and more.

Price is $395 for one. Delivery is 15 days ARO. For more information contact Robert Way, President, (408) 736-3282.

CIRCLE INQUIRY NO. 166

TEST EQUIPMENT

MicroSystem Analyzer

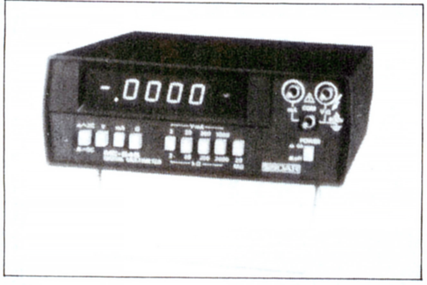
The Intel 8085 MicroSystem Analyzer allows operation by technicians and service personnel with a limited understanding of the system under test. Personnel with varying skills can test products using any and all of Intel's microprocessors.

Unit price is $2,750. Delivery is 45 days ARO. For details contact Millennium Systems, Inc., 19020 Pruneridge Ave., Cupertino, CA 95014, (408) 996-9109, David West, Dir. of Mktg.

CIRCLE INQUIRY NO. 168

4½ Digit High-Accuracy DMM

The Model MC545 is a bench-type multimeter that features five function modes (DCV, ACV, DCmA, ACmA and OHMs) and provides automatic zero adjustment and polarity indication.



The modes appear on the LED display. This highly accurate instrument has a voltage measurement range of 2 to 1000 volts AC and DC; a current measurement range (AC and DC) from 2 to 1000 mA; and a resistance measurement range to 200 megohms.

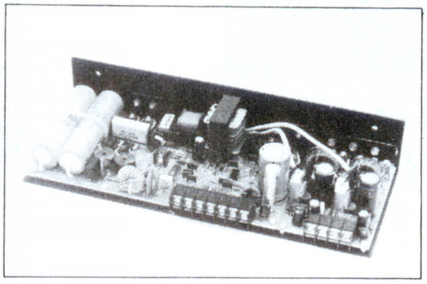
Price is $289.95. Delivery is from stock. For details contact Soar Electronics Corp., 200 13th Ave., Ronkonkoma, NY 11779.

CIRCLE INQUIRY NO. 174

POWER SUPPLIES

Switching Power Supply

A series of 150-watt, open-frame convection cooled AC-DC switching power supplies are designed for use in computer peripherals, business machines and industrial-control systems.



All outputs are fully regulated to 0.1 percent for 92 to 138 volts and 184 to 276 volts AC line condition, and 0.5 percent for 0 to 100 percent load changes.

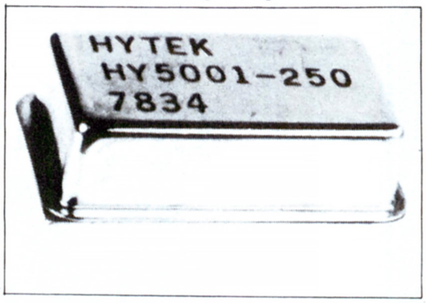
For more information contact Gould/Electronic Components Div., P.O. Box 6050, El Monte, CA 91731, (213) 575-4777.

CIRCLE INQUIRY NO. 177

COMPONENTS

Digital Delay Line

Hermetically sealed in a metal 14-pin DIP package, this delay line is designed to withstand such severe manufacturing processes as wave soldering and freon degreasing.



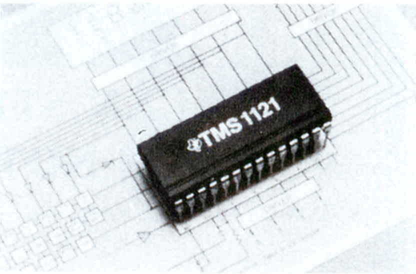
The HY-5001 features Schottky buffered input/ outputs which provide a delay accuracy of ±2ns/ 5%, true waveform reproduction and standard digital fanouts.

Price is $14.80 in OEM quantities. For information contact Hytek Microsystems, Inc., 16780 Lark Ave., Los Gatos, CA 95030, (408) 358-1991, Dick Fryhoff.

CIRCLE INQUIRY NO. 179

One-Chip Universal Timer Controller

The TMS 1121 is a pre-programmed (firmware) version of the TMS 100 single chip microcomputer. The TMS 1121 features 18 daily or weekly selectable timer settings; four independent switched outputs for control of external devices, 50 Hz or 60 Hz line synchronization, and display signal driver input for both day of the week and time of the day.



Price for 100 is $8.61 each. For details contact Texas Instruments Inc., IAS, P.O. Box 1443 M/S 6406 (Attn: TMS1121) Houston, TX 77001.

CIRCLE INQUIRY NO. 182

APPLICATION SOFTWARE from OMEGA MICRO

Finally, Extensive yet Inexpensive Application Programs
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- EMPLOYEE MASTER FILE REPORTS
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DATA BASED MANAGEMENT
- MENU DRIVEN
- CUSTOM DATA FILES:
  May be set up and maintained without need of additional programming.
- CUSTOM REPORTS:
  May be structured or changed anytime
- LINKED DATA FILES:
  Custom files may be accessed by users programs.
- SELF DOCUMENTING:
  Creates complete file documentation on custom files created by user.
- DFD* PROGRAM SPECIFICATIONS

Diskette $98.00 Manual $10.00

SYSTEM HARDWARE REQUIREMENTS
8080 or Z-80 Computer System with 48K RAM or greater
Dual Disk Drives
Digital Research CP/M Disk Operating System
132 Column Printing Device
80 Column by 24 line screen display
Microsoft Disk Extended BASIC

MICROSOFT DISK
EXTENDED BASIC
$350.00

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CIRCLE INQUIRY NO. 76

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YOU CAN STILL GET AHEAD. IT'S NOT TOO LATE.

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A: Eliot Janeway.
Q: Who said utility stocks yielding 11-13% in 1976 would at worst keep you ahead of inflation and at best surprise you with a profit?
A: Eliot Janeway.
Q: Who said gold bought in 1977 would be your best insurance against the collapse of the dollar?
A: Eliot Janeway.
Q: Who said a return to double digit interest rates in 1978 would keep the smart investor close to cash?
A: Eliot Janeway.

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Make checks payable to Janeway Publishing & Research Corp, 15 E. 80th St., New York, N.Y. 10021

CIRCLE INQUIRY NO. 86

LITERATURE

Micro V Brochure

A 4-page brochure from Micro V describes MICROSTAR™, a new low-cost, multi-user, multi-task computer designed for the small businessman. Complete with photos and typical system diagram, this brochure describes the computer in terms of system hardware and software, and also provides full system specifications.

A few of the features highlighted are: STARDOS™ multi-user operation system with BASIC language support; UPDATE data base management and report writer; and the MICROSTAR™ single-board computer design.

For a copy, contact Micro V Corp., 17777 S.E. Main St., Irvine, CA 92714, (714) 957-1517.

CIRCLE INQUIRY NO. 189

Buyers Guide

Releases on software and accessories for the Apple II and the TRS-80 as well as a wide range of computer supplies are listed in "A Buyer's Guide to Software," which is updated weekly. Most items in the guide are in stock and ready for delivery.

The Buyers Guide is free. Send 50 cents for P&H. For details contact Ronald Wallace, Wallace Electronics, Inc., 4921 N. Sheridan Rd., Peoria, IL 61614, (309) 692-2616.

CIRCLE INQUIRY NO. 191

Software Library

Creative Computer Consultants Inc. has published the Standard Software Library, a series of books containing listings of programs written in BASIC with complete documentation.

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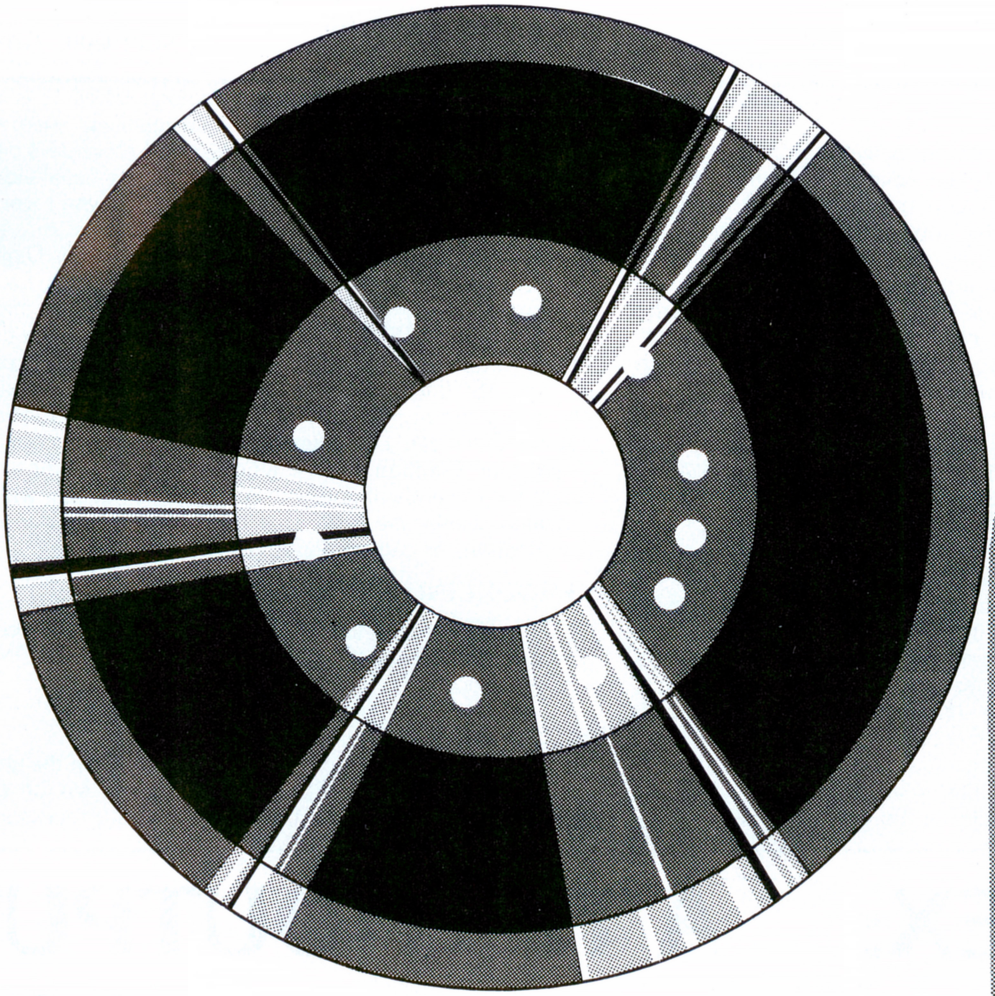
For more information contact Peachtree Software, Suite 419, 3384 Peachtree Rd., N.E., Atlanta, GA 30326.

CIRCLE INQUIRY NO. 204



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TEX: A TEXT-OUTPUT FOR

Review by Alan R. Miller,

INTRODUCTION

Report writing is a common activity of those in the business world. There may be several re-writings of the manuscript before the final version is obtained. The author first creates an outline of the important points, then he expands these ideas into a first version. A secretary converts this into a double-spaced rough draft.

The businessman may add ideas between the lines of the rough draft or may insert new pages. If reorganization is necessary, some of the pages may have to be cut up with scissors and taped back together in the desired order. The final version is created by a retyping of the entire manuscript. This cumbersome process requires authors to carefully organize their thoughts before starting on their report (or to hire very patient secretaries).

USING A COMPUTER

The increasing availability of digital computers with text formatting capabilities is simplifying the task of report writing. One of the tasks that digital computers are especially suitable for is that of text processing. Editors of varying levels of sophistication are built into most BASIC interpreters.

The editors contained in 4K and 8K BASIC are usually limited to the replacement of entire lines, or to the correction of the most recently typed character. EXTENDED and DISK versions of BASIC contain a more versatile editor that allows the user to alter any character in the entire program. Some assemblers also incorporate a text editor. (An assembler text editor was described in the October, 1978, issue of INTERFACE AGE.)

Programs designed to be run with a disk-operating system (DOS) such as CP/M don't need a self-contained text editor. (CP/M was reviewed in the July and December 1978 issues of INTERFACE AGE.) The DOS is organized into a file system and there is a system editor for creating and altering any of the ASCII data files. Thus the user can initially generate his source program using the system editor, then run the program with a BASIC or FORTRAN processor. If an error is discovered during execution, the system editor is used to make the correction. Disk-oriented BASICs such as those written by MicroSoft and Xitan also incorporate their own editor.

TEXT FORMATTING

In contrast to a text editor, there is another class of program that is called a text-output formatter. These programs convert an ASCII work file into a finished file that looks like typewritten copy.

The Electric Pencil is a self-contained, text-output formatter of this type. As the user enters words from the console keyboard, they appear on a video screen. After a file has been written, it can be altered with the built-in editing commands. A disadvantage of this package is that the work file that is ultimately saved on disk is not in its final form. Another disadvantage is that a memory-mapped video-display module, such as the Processor Technology VDM-1, is necessary. While these video systems are relatively inexpensive, they generally display only 16 lines of 64 characters per line, rather than 24 lines of 80 characters that the usual video terminal provides. Furthermore, the VDM-1 doesn't work properly with some Z-80 boards.

A different approach to text formatting is taken by Digital Research, the organization that produced CP/M. They have written a program called TEX that will convert a work file into a formatted print file. The work file is written first, then the finished file is generated with TEX. Finally, the finished file is printed.

The ASCII work file, with a file type of .TEX, is generated by using the regular CP/M text editor ED or the Microsoft editor EDIT-80. The user simply types his lines, paying no particular attention to line lengths. Words are not hyphenated at the ends of lines. Formatting commands, which are located within the text, can be added either during text generation, or can be added later.

PRODUCING A FORMATTED FILE

The TEX source file can be converted to a finished PRN output file by executing the text formatter TEX.COM. The command:

```
A>TEX REPORT5
```

will produce a file named REPORT5.PRN from the work file REPORT5.TEX. The PRN file can be printed on the list device by using PIP, the CP/M peripheral processor:

```
A>PIP LST:=REPORT5.PRN[T8]
```

If, after viewing the resulting PRN file, the user wants to make corrections, the CP/M system editor can be used to alter the .TEX work file. Then TEX.COM is rerun to produce the revised PRN file. Several PRN files can be combined into one master file using PIP:

```
B>A:PIP REPORT.PRN=REPORT5.PRN,PROGRAM.PRN
```

where REPORT5 could be a file formatted by TEX and PROGRM could be an assembly listing produced by MAC or ASM.

THE FORMAT COMMANDS

There is a complete set of format commands that are placed between the regular lines of text in the TEX file. All of these commands start with a period as the first character on the line. Some of the commands are placed at the beginning of the TEX file. These will generally control formatting for the entire file and may override default options.

Other commands are placed throughout the text and usually apply to the next line or paragraph. All of the commands are discussed in detail in the user's manual. Some of the more useful ones will be described, primarily to indicate the power of TEX.

THE DEFAULT VALUES

Some of the commands are automatically preset to common values. Thus the page length defaults to 11 inches, the right and left margins are justified (aligned), line length is 70 characters, new paragraphs are indented 6 spaces, and the text is single spaced.

Listing 1 is the first part of the TEX work file for this article and includes some typical format commands. The resulting PRN file produced by TEX is shown in Listing 2. Notice that the source file is single spaced with irregular line lengths, while the finished file is double spaced with justified margins.

SELECTED COMMANDS

The first command in Listing 1, .LL55 sets the line length to 55 characters, overriding the default value of 70. The next command, .IG directs TEX to ignore the following lines until the next command is encountered. This command can be used to enter comments, such as the revision date, that are not to be printed in the finished file. Notice that commands may be entered in either upper or lower case letters.

The command .CE3 causes the next three lines to be centered. Then the .DS command produces double spacing between each line, overriding the default value of single spacing. The .SP adds an extra space before the heading INTRODUCTION. The .TI3 command that follows does two things. It produces a temporary indentation (for only one line) of three characters. And it also causes a break in the margin adjustment. Without a break, TEX would attempt to fill out the rest of the line after the heading:

INTRODUCTION Report writing is a common . . .

FORMATTER CP/M

Contributing Editor

For a report that is to be single spaced, the paragraph command, .PP is more suitable than the .TI command. Another useful command is the literal, .LI which instructs TEX to print the text exactly as it appears. This is useful for including assembly listings within the body of the article. Although there are a total of 26 commands available, the following seven basic commands are likely to be the ones used most often.

.CEn	[center the next n lines]
.DS	[double space the text]
.IG	[ignore the next section]
.LI	[literal, use as is]
.LLn	[let line length to n]
.SP	[insert a space, vertically]
.TIn	[temporarily indent n]

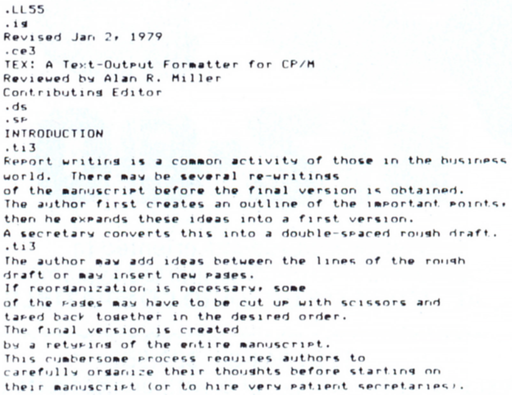
THE MANUAL

TEX comes with a 78-page user's manual. The first part presents a thorough summary of CP/M in general and the system editor, ED in particular. The operation of TEX is explained and the 26 TEX formatting commands are then discussed in detail.

All of the commands are listed on a single page in the appendix, making a convenient reference for the beginner. The manual is written in a non-technical style, so a person with little experience in computer programming should be able to use TEX.

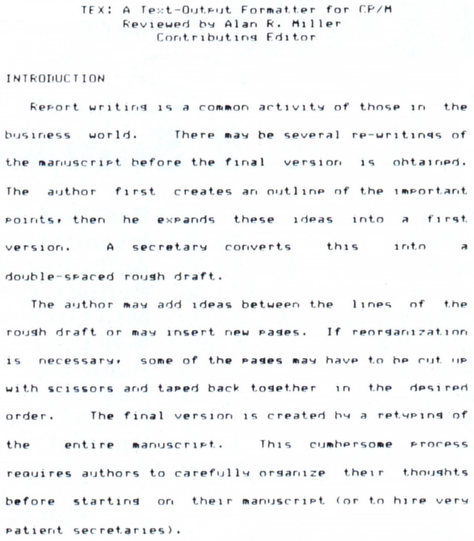
I have found TEX to be a most helpful computer program. I use it to format all of the articles I write, as well as for technical reports in my regular work.☐

Sample 1. Original work file.



```
.LL55
.ig
Revised Jan 2, 1979
.ce3
TEX: A Text-Output Formatter for CP/M
Reviewed by Alan R. Miller
Contributing Editor
.ds
.sp
INTRODUCTION
.ti3
Report writing is a common activity of those in the business
world.  There may be several re-writings
of the manuscript before the final version is obtained.
The author first creates an outline of the important points,
then he expands these ideas into a first version.
A secretary converts this into a double-spaced rough draft.
.ti3
The author may add ideas between the lines of the rough
draft or may insert new pages.
If reorganization is necessary, some
of the pages may have to be cut up with scissors and
taped back together in the desired order.
The final version is created
by a retyping of the entire manuscript.
This cumbersome process requires authors to
carefully organize their thoughts before starting on
their manuscript (or to hire very patient secretaries).
```

Sample 2. Formatted file.



```
         TEX: A Text-Output Formatter for CP/M
             Reviewed by Alan R. Miller
                 Contributing Editor

INTRODUCTION

   Report writing is a common activity of those in  the

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A SIMPLIFIED METHOD OF BINARY NUMBER SUBTRACTION

By S. Leon Felkins

INTRODUCTION

For most, binary number addition is a fairly easy concept to absorb since it is essentially no different than base 10 addition. It is known that when two base 2 digits are added, a one is carried to the next column if the total is greater than one. On the other hand, it is difficult to get really comfortable with base 2 subtraction. While, again, it presents no new principles beyond base 10 subtraction, borrowing can get complicated, particularly when a borrow "propagates" over about 6 columns.

This article shows a method that reduces the subtraction problem to, essentially, the same method as addition and without going into complementary numbers. With the method presented here, if two binary numbers can be added, subtracting one from the other should be just as easy. Implementation in hardware will also be shown.

THE TRUTH TABLE

We know that when 0 and 0 are added the result is 0; 0 and 1 = 1; and 1 and 1 = 0 with a "carry" of 1. This set of rules can be neatly summarized in a "Truth Table." The truth table simply defines the above stated function for all possible inputs. Consider two numbers, X and Y, which are added together to get the sum, S plus a possible carry, C. The truth table looks like this:

Input		Output	
X	Y	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Of course, S and C could also be expressed as Boolean functions:

$$S = X \oplus Y$$
$$C = X \bullet Y$$

but the truth table illustrates the ideas more clearly.

Really, the problem is a little more complex because a carry could result from the *previous* stage. Again, rules must be stated in the form of a truth table. (It is assumed that two numbers are considered at a time throughout this article. Adding more than two numbers can always be reduced to successively adding a pair at a time.) The subscript "i" has now been added to show that the "i"th stage or column is considered.

ADDITION

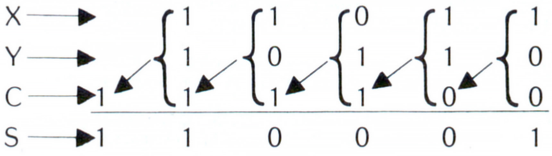
Input			Output	
X_i	Y_i	C_i	S_i	C_{i+1}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

This addition table suggests a simpler rule for addition than has been used. Rather than being concerned about "sums" and "carries," why not just consider it as obtaining two outputs, S_i and C_{i+1} based on the following rules:

S_i: S_i has a value of 1 if and only if there are an odd number inputs having a value of 1.

C_{i+1}: C_{i+1} has a value of 1 if and only if there are two or more inputs having a value of 1.

The method is illustrated by a simple example. The problem will be arranged in a format useful to the present purpose.



Each stage is discussed:

Stage 1: Carry is always 0 at the first stage. Using the above rule results in $S_1 = 1$ since there are an odd number of ones and $C_2 = 0$ since the number of ones is less than 2.

Stage 2: $S_2 = 0$ results because there are an even number of ones and $C_3 = 1$ because the number of ones is two or greater.

Stage 3: Same as Stage 2.

Stage 4: Same as Stage 3.

Stage 5: $S_5 = 1$ results because there are an odd number of ones and $C_6 = 1$ because the number of ones is two or greater.

Stage 6: Same as Stage 1.

Now look at the truth table for subtraction. Let D represent the difference, B represent the "borrow," X represent the minuend and Y represent the subtrahend.

SUBTRACTION

Input			Output	
X_i	Y_i	B_i	D_i	B_{i+1}
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Notice some similarities. D_i is exactly the same as S_i. B_{i+1}, while not exactly the same as C_{i+1}, does have some similarities. It appears that B_{i+1} is the same as C_{i+1} is the complement of X_i (X_i') is used rather than X_i. That could be used, but there is an even simpler method for manual operations. The rules for subtraction:

D_i: D_i has a value of 1 if and only if there are an odd number inputs having a value of 1.

B_{i+1}: B_{i+1} has a value of 1 if and only if there are two or more of the three quantities Y_i, B_i and D_i that have a value of 1.

In other words, for subtraction, the same rules apply as addition, except that for the inputs the three center columns, Y_i, B_i, D_i, are taken instead of the three left most columns as done in addition. The following example illustrates how this rule is applied:

X →		1	1	0	1	1
Y →		1	0	1	1	0
B →	0	0	1	0	0	0
D →		0	0	1	0	1

Each stage is discussed:

Stage 1: Borrow is always 0 at the first stage. Using the above rule, $D_1 = 1$ results since there are an odd number of ones and $B_2 = 0$ since the number of ones in the Y, B and D positions is less than 2.

Stage 2: $D_2 = 0$ results because there are an even number of ones in X, Y and B positions and $B_3 = 0$ results because the number of ones in the Y, B and D positions is less than 2.

Stage 3: $D_2 = 1$ results because there are an odd number of ones in X, Y and B, and $B_4 = 1$ results because the number of ones in the Y, B and D positions is not less than 2.

Stages 4 and 5: Same as Stage 2.

HARDWARE IMPLEMENTATIONS

Since, as stated above, the correct values for B_{i+1} could be obtained by simply inputting X_i' to the C_{i+1} calculator rather than X_i. The Boolean expressions for S_i and C_{i+1} are:

$$S_i = X \oplus Y \oplus C_i$$
$$C_{i+1} = X \bullet Y + X \bullet C_i + Y \bullet C_i$$

Assuming these two circuits are available, a circuit can easily be built to add or subtract by implementation of the following set of Boolean equations:

$$S_i/D_i = X \oplus Y \oplus C_i$$
$$C_{i+1}/B_{i+1} = (X \odot ADD) \bullet (Y + C_i) + Y \bullet C_i$$

Where ADD is a Boolean variable that, when asserted, causes the circuit to properly add and, when false, causes the circuit to properly subtract. The ADD variable causes X to be input for the add operation but causes X' to be input by the subtract operation.☐

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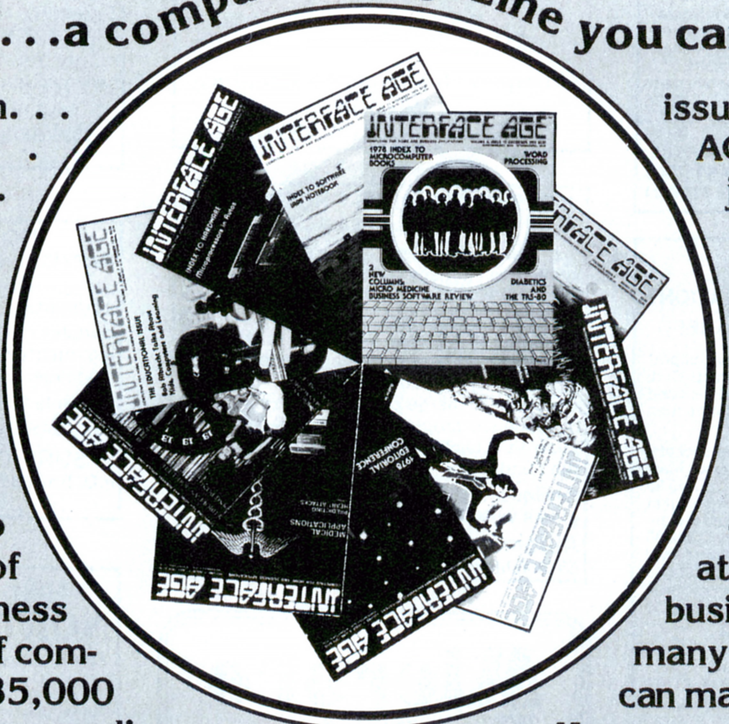

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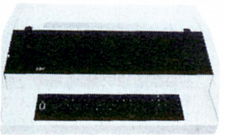

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ADVERTISER INDEX

Info Inquiry Number		Page
MANUFACCTURERS		
1	ACS Service	28
2	Anadex	56-57
3	Analex	43
4	Atari	4-5
5,6	A-Vidd Electronics	32, 33
7,8	Berkeley Medical Data Associates, Inc.	22,40
9	Cascade Enterprises	18
10	Computerland, Inc.	25
11	Computer Lab of New Jersey	24
•	Computer Cookbook	16
12	Cromemco Inc.	1
13	Cutting Edge of Technology	37
14	Cybernetics Inc.	43
15	Data/Print Publishing	34
16	DataSearch	22
•	dilithium Press	26-27
17	Essex Publishing Company	131
•	80-US	132
18	Electronic Control Technology	50
19	FMG Corporation	152
20	GRT Corporation	3
21	Gimix Inc.	14
22	Graham-Dorian	36
23	Integrand Research	18
24	Intelligent Systems Corp.	BC
•	INTERFACE AGE Subscriptions	149
		Plus insert between pages 16 & 17
•	INTERFACE AGE Back Issues	148
25	Intertec Data Systems	15
86	Eliot Janeway	142
26	Konan	31
27	Lifeboat Associates	93
28	Meca	38
29	Micro Computer Technology Inc.	41
30	Micro Da Systems	8
31	Micro Mail	39
32	Micro-Term, Inc.	29
33	Micro V	21
34	Micro Works	24
35	Micropolis	44-45
36	MPI	20
•	NRI	51
37	National Software Exchange, Inc.	49
38	National Technical Schools	20
39	Ohio Scientific	IBC
•	Osborne & Associates, Inc.	136
40	Otto Electronics	30
41	J.M. Overholtzer Computer Eng.	100
42	Pacific Digital	46
43	Percom Data Company, Inc.	9
44	Pragmatic Designs Inc.	35
45	Ready Corporation	42
46	S.D. Systems	7
•	Shugart	10, 11
•	Small Business Computers Magazine	137
47	Softside	146
48	SWTPC	IFC
49	Structured Systems Group Inc.	13
57,83	Sybex	118-119
50	Tarbell Electronics	37
51	Teletek	19
52	Terminal Systems Inc.	46
53	Univair International	100
54	Vector Electronic Inc.	17
55	Vector Graphic Inc.	23
56	Western Digital	12
COMPUTER STORES/SURPLUS STORES		
58	Advanced Microcomputer Systems	132
59	Bits N Bytes, Fullerton, CA	126
60,61	Byte Shop, Lawndale, CA	133, 139
62	Century Electronics	125
63	Computer Components of South Bay, CA	135
64	Computer Components Inc., Van Nuys, CA	138
65	Computer Components of Orange County	114
71	Computer Systems Design, Inc.	124
84	Data Discount Center	125
66	Digi-Key Corporation	126
67	Hobby World	115
68	Jade Computer Products	127, 128, 129
69	Khalsa Computer Systems Inc.	113
70	Marketline Systems, Inc.	120
72	Micro Mike's, Inc.	133
73,74	MiniMicroMart, Inc.	102, 134
85	MicroWorld	104
75	Mission Control	143
76	Omega Micro Computers	141
77	Personal Programming Service	140
78	Quest Electronics	122
79	Rainbow Computing, Inc.	124
80	Star-Tek Electronics	131
81	Sunshine Computer Company	121
82	T & W Communications Centers	117

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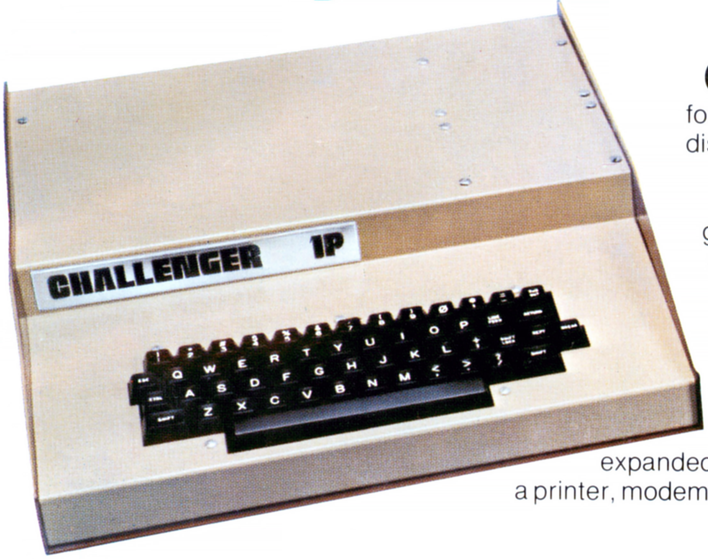

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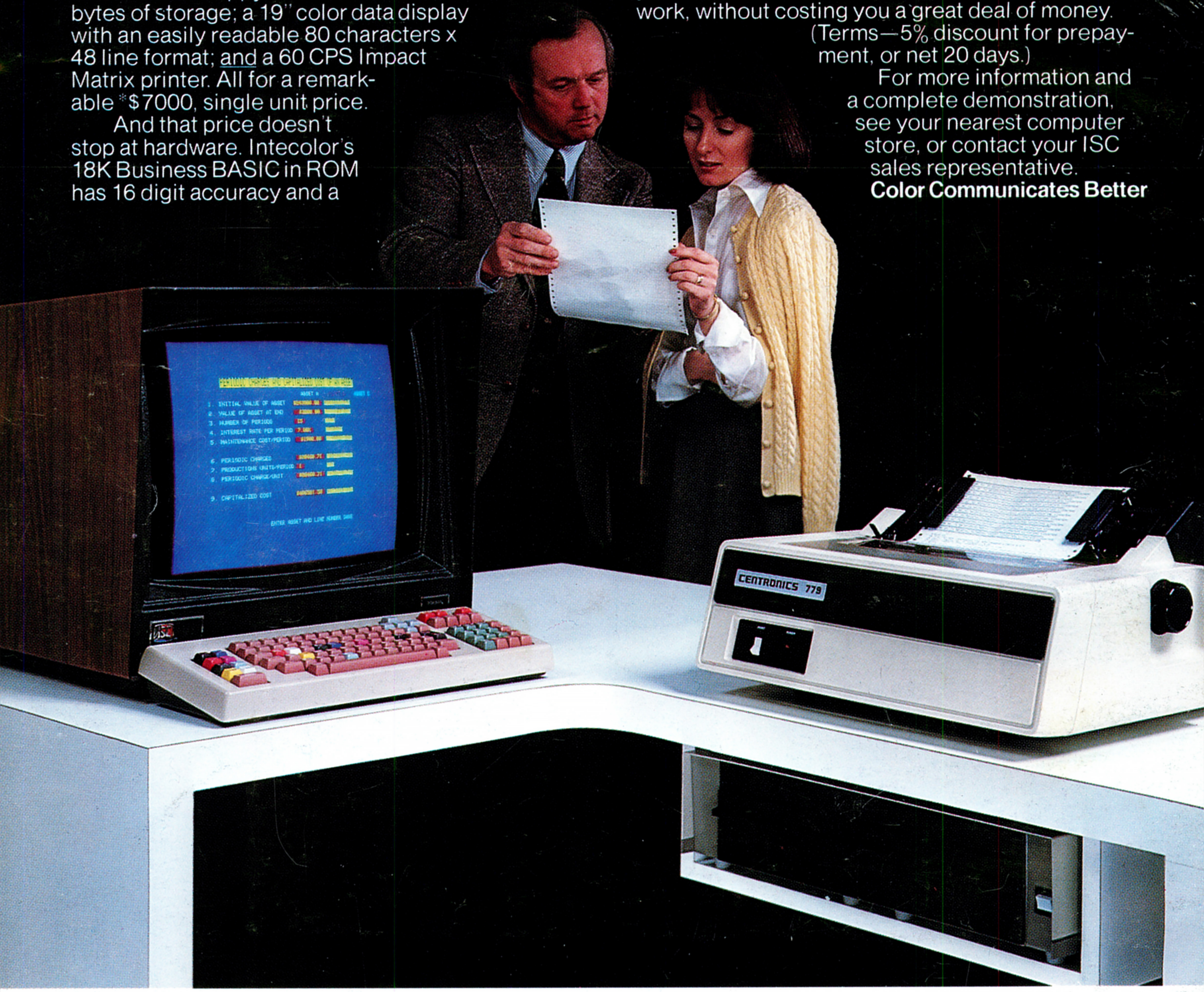

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